Letters

YURIMAGUAS TECHNOLOGY

I find it seldom worthwhile making a statement aimed at counteracting a published article that is designed to influence policies on ecological planning or management. However, the recent article by Philip Fearnside (*BioScience* 37: 209–214) on "Rethinking Continuous Cultivation in Amazonia" has induced me to do so. The article presents a one-sided and incomplete view of the "Yurimaguas Technology," and if its message is accepted by those who influence Amazonia policies, it could have an unfortunate and retrogressive effect on what I believe is a very promising development.

My own examination of the Yurimaguas experiments, in mid-1986, does not support Fearnside's strong rejection of this interesting work. I do not wish to take issue with all of the technical details of his criticisms; the leaders of the research program can do that themselves. I would like, however, to make the following points:

- In my discussions with the Yurimaguas staff and research leaders, the technology was not promoted as "the" answer to all Amazonia problems, but as "one" answer—and a good one.
- An important point, which is ignored in the article, is that, if done correctly, intensive agriculture is not necessarily ruinous in tropical rain forest regions. I examined soil pits in undisturbed forest and in an adjacent land that had had 22 consecutive crops in seven years. The A horizon was slightly deeper in the cropped area, and the chemical and physical properties were virtually the same—admittedly (and not surprisingly) as a result of additions of lime and phosphate. This fact denies the very widely promoted myth that all tropical rain forest soils are immediately and irrevocably destroyed by cultivation.
- The experiments encompass a range of sophistication and intensification, from high technology to a system based on zero tillage and rotational fallow (including smother crops to obviate the need for herbicides), in which the trees are felled without stumping. Emerging research findings on the importance of synchrony in nutrient release and plant uptake are being incorporated into current research at Yurimaguas. It is refreshing and encouraging to witness a progressive research program that is receptive to advice and criticism and is adapting to new information.
- The problem of erosion on sloping soils is not unique to Amazonia. Once the flat areas have been used, increasing conservation measures (such as contour banks) must be taken on cultivated lands. This applies in southeast Asia, Africa, and South America. It is a problem with any form of agriculture and should not be especially associated with the Yurimaguas methods. The most important requirement is to keep the soil covered at all times, a principle of Yurimaguas systems.
- I am not convinced by Fearnside's refutation of the argument that increased productivity of arable lands will reduce the pressure on clearing more forests. Food production worldwide is increasing and markets are hard to find. It is becoming more important to increase efficiency of production than total production. Whether a relatively wealthy farmer invests in low-intensity cattle production on extensive, cleared areas or in the very high production pastures being developed at Yurimaguas will be dictated by their relative economics. I agree that the deforestation process needs to be examined more closely (and it would be useful to look at comparable areas in Africa), but I do not believe that rejection of the Yurimaguas view is warranted.

The Yurimaguas research has provided a great deal of very useful information. It is a well-conducted and progressive program that has much to offer. It deserves much better than the denigration contained in Fearnside's article, and I sincerely hope that the one-sided and mostly unwarranted criticism will not have a negative effect on the future of the program.

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I wish to comment on Philip Fearnside's recent article, which I consider scientifically biased and politically dangerous.

As a soil ecologist, I have studied soils and their management in a variety of tropical countries—western Africa (especially Côte d'Ivoire), Congo, Mexico, and Venezuela. Last year I started a research program on Yurimaguas on some biological aspects of soil fertility as part of the IUBS/MAB-UNESCO Tropical Soil Biology and Fertility (TSBF) program. This work gave me the opportunity to see the research being done there, and I was most impressed.

The first unfair aspect of Fearnside's paper is to speak of "the" Yurimaguas technology when a great variety of technologies are being tested there. These technologies, only evoked in one short sentence, range from low to high input and include a large variety of crops and associations that make the station one of the better examples of tropical agronomic research. The so-called Yurimaguas technology is an advanced and sophisticated one. It demonstrates that a high level of scientific and technical knowledge may give good results when applied to tropical agriculture. This is not the first experiment that has given such results, and further research is likely to simplify and improve this technology.

In the present socioeconomic situation of many tropical countries, this technology will develop slowly. However, techniques derived from the Yurimaguas experience, which require less input and knowledge, are likely to expand. Most tropical countries are developing, sometimes slowly, which means that the quality of human resources and the average level of education are improving, as well as the infrastructures. Young people trained in agriculture or agronomy are thus able to use more sophisticated techniques and are understandably keen to live better than their parents.

The second side of the problem is the socioeconomic and environmental context of agricultural practices. Some of Fearnside's criticisms of high-input technology, particularly its possible impact on environment, are reasonable, though probably exaggerated. An example is techniques available to prevent erosion on steep slopes even in low-input agricultural systems. The absence of winter to control pests does not seem a really serious problem when other factors, such as seasonal drought or the impact of predators, have been shown to have equally significant effects. These problems, however, are not specific to the tropics.

High-input agriculture in temperate countries is facing serious problems, such as soil erosion, the movement of nitrates towards water tables, and heavy metal accumulation due to the impurities of fertilizers or sewage sludge. These problems emphasize the need to improve current technology, including a better monitoring of soil biological processes. Though serious, these problems appear unlikely to threaten severely the productivity of agriculture.

On the other hand, traditional shifting cultivation used over much of the tropical world is a true cul-de-sac. It is destructive, especially in conditions of reduced fallow periods when available land runs short. It is also a subsistence agriculture, which will never lead to economic development. This agriculture is thus less and less appealing to young people who have higher levels of education and more need to consume than their parents and grandparents. I know of some countries where these people prefer to live in towns rather than carry out this kind of agriculture.

If high- or intermediate-level technologies are not developed, the only alternative is shifting cultivation, which has largely demonstrated its limitations. Refusing technology implies the choice of something even more destructive and with no economic future. Is that what Fearnside recommends? High-input technologies for oil palm, rubber, or sugar cane production are already being successfully used in some countries, for example Côte d'Ivoire, Cameroon, Southeast Asia, and Australia.

In the present socioeconomic context of most tropical countries (including Amazonia), high technologies perhaps offer incentives for young cultivators to improve their techniques rather than a readily applicable option. A variety of intermediate techniques, including low-input sustained agriculture based on the manipulation of biological processes (as proposed, e.g., in the above-mentioned TSBF program), is being examined at Yurimaguas. Such diverse manipulations as intercropping, application of mulches of specified qualities, and introduction of earthworm species are being tested in this program.

The work performed at Yurimaguas and at several comparable stations in the tropics is very much needed to provide solutions for the future. It is both appealing for the cultivators and stimulating for the scientists. Fearnside's argument would have applied to the situation observed 10 or 20 years ago, and it seems unduly pessimistic when the average education level of populations has increased. People have a legitimate need for a better life, and the problem of environmental destruction linked to shifting cultivation has no solution. Possible problems should not be underplayed, but there is reason to hope for economic development based on good-quality agriculture. Adequate policies and the positive and efficient participation of scientists are required. There is also reason to hope that this technology will be accompanied by satisfactory levels of environmental protection, since, for example, improvement of soil quality is pointless unless parallel measures are taken to ensure its conservation.

The conclusion of the 1978 FAO report "Agriculture towards 2000" leaves no other option than rational development to ensure the necessary doubling of food production in the tropics over the next 20 years.

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In "Rethinking Continuous Cultivation in Amazonia," Philip M. Fearnside argues that the Yurimaguas technology cannot be applied, due to the insufficient prerequisites presently prevailing in Amazonia (such as inadequate infrastructure, competition disadvantages, poor education, and lack of capital of the Amazonian farmers). He emphasizes the dangers of erosion on sites with alfisols and vertisols, he mentions the limited reserves of rock phosphate, and he points out the farmers' poor response to the new technology in that area. Finally, he expresses his fears that the new technology will eventually lead to more rapid deforestation.

This article does no justice to a most ambitious agroecological task, and it should nor claim the pretentious term *rethinking*. Rethinking would require that first, the ecological problem and the scientific approach, linked with the Yurimaguas experiments, are presented. Then the results from the project should be analyzed using criteria provided by natural sciences. Only by so doing, can one do justice to this difficult, carefully performed, and well-documented scientific research of many years.

In order to make my position more precise, I should add my opinion on the Yurimaguas technology. In my studies on the ecological difficulties of tropical land use, I analyzed the data of the Yurimaguas experimental station. I became convinced that only a small number of locations in the humid tropics are as yet suitable for applying the Yurimaguas technology, which, in its present state, does not represent a general breakthrough to a new era of crop production on tropical ultisols and oxisols. But I still esteem the scientific work carried out at Yurimaguas. With their sophisticated experiments, Pedro Sanchez, Dal Bandy, José Benites, and the other team members have contributed tremendously to our understanding of the intrinsic disadvantage of tropical agriculture and of how difficult it is to manage an ecosystem of permanent crops on tropical low base status soils.

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PLASTIC WORLDS

In a recent letter, Kenneth Thimann wondered why endangered species such as Furhish's lousewort cannot be protected in botanical gardens, or the snail darter preserved in aquariums (*BioScience* 37: 5). His letter conjures up visions of a plastic world in which biological diversity is relegated to zoos, gardens, and other refuges provided by humans.

Thimann apparently sees no difference between an organism in a cage or a greenhouse and that same organism in its natural habitat. The fascinating and complex interplay of living things with their environment, which provides the framework for evolution, can hardly be simulated in an artificial setting.

Moreover, saving an organism under artificial conditions is often much more difficult than protecting it in its native habitat. We can take Furbish's lousewort as an example. Recent population ecology studies on this slow-growing riverbank herb show it to be an obligate hemiparasite. It does not reproduce vegetatively, and seeds are not produced until plants are at least three years old. Lousewort populations grow best on steep riverbanks and seem to require periodic ice scouring and bank slumping to provide new colonization sites. Much remains to be learned about the pollination, seed germination, and growth requirements of this species (Menges and Gawler 1986, Menges, Waller, and Gawler 1986). Yet Thimann thinks that nothing would be simpler than to dig these plants up and grow them in a botanical garden.

The notion that we can count on zoos to save endangered animals is equally absurd. According to William Conway of the New York Zoological Society, if zoos were required to maintain viable reproductive populations of the animals they keep, existing capacity would allow for the maintenance of no more than 900 species. There are an estimated five to ten million animal species on Earth.

Our best hope for the perpetuation of endangered species lies in protecting natural habitats. Zoos and botanic gardens have important roles to play in research and education, to be sure, but let us not count on them to save the large numbers of animals and plants currently facing extinction.

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REFERENCES CITED

Menges, E. S., and S. C. Gawler. 1986. Four-year changes in population size of the endemic Furbish's lousewort: implications for endangerment and management. *Nat. Areas J.* 6: 6–17.

Menges, E. S., D. M. Waller, and S. C. Gawler. 1986. Seed set and seed predation in *Pedicularis furbishiae*, a rare endemic of the St. John River, Maine. *Am. J. Bot.* 73: 1168–1177.

NEXT-TO-NO BUDGET FOR TREES

According to Donald E. Davis (*BioScience* 36: 700), "Small universities and junior colleges often rule out the idea of establishing arboretums because they assume that such facilities require a large amount of land and a substantial maintenance budget. This need not be true." He described the Auburn University Arboretum, a valuable, low-cost aboretum developed on a university-owned site.

Smaller universities without adjacent land holdings do have problems that interfere with the establishment of an outdoor botanical laboratory. We at the College of William and Mary have devised a number of programs designed to use imagination along with very limited resources and space. Our program has involved documentation, maintenance, and expansion of our woody plant collection, which is integrated into the campus landscape. The late John T. Baldwin, who initiated our collection, said "a collection of living plants at an academic institution should be comparable to that of a collection of books in the library."

We first identified, located, and mapped existing woody species; then we compiled this information in an inventory book that documents the trees and shrubs on our campus. We next obtained formal administrative support. Resolutions adopted by our governing Board of Visitors have established a Wildflower Refuge and the John T. Baldwin, Jr., Collection of Woody Species. We established a working relationship with the building and grounds staff and landscape architects. Finally, we developed programs to provide funds for the purchase and maintenance of native and exotic woody species.

Our approaches include

- A Living Remembrance Program, which ensures continuing introduction of exotic species. (Desired species are purchased and held for planting when a donor is identified. A small brass plaque [mounted flush for ease of mowing] is included. A variety of in vivo remembrances are encouraged.)
- A program of Senior Class Trees, which provides additional trees, and an ancillary alumni collection.
- A program of small garden development. (Private funds have been designated to support individual garden areas containing trees and shrubs.)
- Reservation of an area for native Virginia species.
- An informational program designed to call attention to our unique col-