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Dear Editor,

It is a pleasure to reply to the letters by B.H. Walker, P. Lavelle, and W. Weischet (BioScience 37(9): 638-640) commenting on my article "Rethinking continuous cultivation in Amazonia" (Fearnside, 1987a). My article discussed the Yurimaguas technology experiments in Peru and questioned both the feasibility of applying the system to wide areas in Amazonia and some of the potential economic and environmental benefits claimed by the system's inventors (Nicholaides et al. 1985; Sánchez et al. 1982).

The three letters defend the technology and merit a point-by-point rebuttal.

WALKER:

Walker begins his letter by stating that he does "not wish to take issue with all of the technical details of (Fearnside's) criticisms; the leaders of the research program can do that themselves." Needless to say, it is these technical details that lend force to my argument. If one is to refute an argument, one must either present evidence showing that the premises on which it is based are false or one must show that the logic used to draw conclusions from those premises is faulty. One cannot simply disagree with the conclusion. To my knowledge, the Yurimaguas project leaders have not yet responded to the article. It should also be mentioned that a draft of the manuscript was sent to all of the Yurimaguas authors over a year before publication. Only one (J.H. Villachica) responded with comments (some of which were mentioned in the article). I interpret this silence as a confirmation that the facts and reasoning are correct as presented.

Walker goes on to say that the Yurimaguas researchers had not promoted the technology "as 'the' answer to all (of) Amazonia('s) problems, but as 'one' answer--and a good one." I did not say that the Yurimaguas researchers had claimed to have found such an all-encompassing answer (although government planners are tempted to interpret their claims in this way). Nevertheless, as demonstrated in my article, the system's potential contribution to solving Amazonia's problems is less than was claimed by Nicholaides et al. (1985) and Sánchez et al. (1982). Decrease in deforestation is not likely to materialize, largely because of the non-subsistence motivation of most clearing in the region (Fearnside, 1987b).

Walker's next point is that "if done correctly, intensive agriculture is not necessarily ruinous (for soil properties) in tropical rain forest regions." As Walker concedes, this is not disputed in my article. However, the "if done correctly" caveat is essential--and not likely under real circumstances in Amazonia.

The point is raised that "the experiments encompass a range

of sophistication and intensification, from high technology to a system based on zero tillage." Only the high-input system known as the Yurimaguas technology was the subject of my article; the presence of other experiments at the station to which my criticisms do not necessarily apply was clearly stated at the outset of my article.

Soil erosion is dismissed as "a problem with any form of agriculture." Walker observes that when land is not flat "conservation measures (such as contour banks) must be taken on cultivated lands." Faith that farmers will take the appropriate soil conservation measures when the need arises is heartening, but the record in Amazonia is poor so far. Walker goes on to state that "the most important requirement is to keep the soil covered at all times, a principle of Yurimaguas systems." While continuous cover is indeed desirable, it is not possible in the "Yurimaguas technology" of continuous cultivation: land must be left bare for some time between crops and when the crop plants are too young to cover the soil.

Walker is "not convinced by Fearnside's refutation of the argument that increased productivity of arable lands will reduce the pressure on clearing more forests." However, he follows this with statement that, if he considers its implications, should help convince him: "Whether a relatively wealthy farmer invests in low-intensity cattle production on extensive, cleared areas or in very high production pastures being developed at Yurimaguas will be dictated by their relative economics." This was precisely my point: the extensive system is presently more profitable, especially when contributions from land speculation are included. Policies to remove the profitability of unsustainable systems are needed urgently, and cannot be substituted for by the technology.

Walker concludes by saying that the Yurimaguas research "deserves much better than the denigration contained in Fearnside's article." While disagreeing strongly with the interpretation Nicholaides et al. (1985) and Sánchez et al. (1982) give to their results, my paper does not denigrate the research. Considerable care was taken in drafting the article so as not to appear to do so.

#### LAVELLE

Lavelle begins by saying that he considers my article "scientifically biased and politically dangerous." Neither charge is substantiated. They appear to be based on the mistaken assumptions that my article should discuss all of the various lines of research underway at the Yurimaguas Experiment Station rather than only the high-input continuous cultivation system, and that I advocate shifting cultivation as the alternative to the Yurimaguas technology.

Lavelle writes that it is "unfair to speak of 'the'

Yurimaguas technology when a great variety of technologies are being tested there." I would remind him that the term Yurimaguas technology was given to the high-input continuous cultivation system by the research team itself (see Nicholaides et al., 1984, 1985). This is the system that is the subject of the article in BioScience by Nicholaides et al. (1985), and which has become known and influential in Amazonian development planning circles. My article was not intended as a review of the Yurimaguas Experiment Station's research program, but as a discussion of the Yurimaguas technology and its development implications.

Lavelle asserts that "if high- or intermediate-level technologies are not developed, the only alternative is shifting cultivation." I certainly do not accept this dichotomy, and neither do the Yurimaguas researchers (see Fearnside 1983, Sánchez and Benites 1987). Lavelle pursues this line of reasoning to the point where he even questions whether I believe that "people have a legitimate need for a better life." I would direct him to the extended discussion of the goals of development in my book (Fearnside 1986).

#### WEISCHET

Weischet is in the odd position of chastising me for having written the article while basically agreeing with it. He says the article "does no justice" to the Yurimaguas technology, and that to qualify as "rethinking" the project would have to be "analyzed using criteria provided by natural sciences." My discussion not only questions the features of the technology that run counter to limits indicated by natural science but also addresses the technology's social and development policy aspects. These non-natural science criticisms are no less valid or important.

Weischet writes that "only a small number of locations in the humid tropics are suitable for applying the Yurimaguas technology, which, in its present state, does not represent a general breakthrough to a new era of crop production," and that the Yurimaguas team has "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." That was exactly my point.

The three letters taken together provide a gratifying indication that I hit the mark rather well in my article. Most striking is what has not been questioned by my critics: the main points in my paper that lead to its strong conclusions (economic performance, labor requirements, resource availabilities, and the dependence on subsidies). The published letters appear to express shock that a cow so sacred could be questioned but do not refute my argument.

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