Retaining and Regaining Agricultural Productivity of Degrading Uplands

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Ginger plants from different cultivation methods, from left: slash-and-burn; slash-and-mulch; slash-and-mulch plus 50 kg of phosphate applied per hectare; and slash-and-mulch plus 100 kg phosphate.

In the rain forest region of Madagascar, shifting cultivation is the predominant form of agriculture. Soil fertility restoration in the uplands is solely based on natural fallows. In the Beforona area on the eastern side of the island, fallow periods have drastically decreased from 8 to 10 years some 20 years ago, to 3 to 4 years today. Fallow areas are cut and burned, and upland rice, ginger or manioc are cultivated for one or two seasons.

The main reasons for these short fallow periods are increasing population and the non-availability of new land, as all the primary forest has already been cleared. But these fallow periods are much too short to restore soil fertility. With each cropping cycle, yields decline. Only four to five cropping cycles after deforestation, fallows are dominated by invasive grasses such as *Imperata cylindrica* and fern species with no economic value. At this stage, farmers abandon upland rice cultivation on this land. Sometimes these plots are used for ginger and manioc, but ginger especially is a very extractive crop, thus degrading the soils even further.

Natural soil fertility restoration from a *Imperata cylindrica* or fern fallow usually takes more than 20 years. More and more land is thus falling out of production. Farmers estimate that within the next 10 years most upland areas will be dominated by *Imperata*.

From the government side, there is no effective strategy to counteract this degradation on a large scale. Farmers are left alone, without access to new information or improved techniques. With decreasing yields, their food insecurity and poverty increase.

Farmers would like to grow more lowland rice to take the place of upland rice, but the areas suitable for irrigated cultivation are limited due to the terrain. Even switching to lowland production is not a solution in itself because hillsides keep eroding, and subsequently water and wood become scarce, already a common feature in the region. It is thus important to keep the uplands under production but in ways that improve and sustain their productivity.

Agricultural experimentation with farmers under the LDI/CIIFAD program replaced burning with mulching practices and added phosphorus (P), one of the most limiting nutrients, to the soil with guano-phosphate applications. Traditional cultivation practices and crop management were retained, so that our results are directly transferable to farmers' condition. We opted for a common rotation: upland rice, followed by beans as a three-month winter crop, and then by ginger. Yield results are presented in the table below:

The first crop was slightly better with the slash-and-burn (SB), but with the second and third crop, yields declined drastically due to rapid loss of nutrients with this management system. For the rice crop, yields were similar under slash-and-mulch (SM) with guano-phosphate (GP) as with SB. For the beans, yields were three to four times higher under SM+GP than with SB. Yields were more then doubled for ginger, the important cash crop in the region. SM by itself was not sufficient to restore soil productivity in the short term, but some yield improvements could be observed with the ginger crop.

Witnessing these yield differences stimulated farmers' interest. In the next cropping season, LDI is integrating these results into its recommendation guidelines for production of "ecologically produced ginger," which will allow farmers to obtain a higher price for their crop.

Yields of upland rice, beans, ginger (kg/ha) planted after a natural fallow dominated by *Rubus mollucanus*, with a medium fertile soil

	upland rice	beans	ginger
Slash-and-burn (SB)	832	201	3400
Slash-and-mulch (SM)	712	181	5310
SM + 50kg/ha P (guano-phosphate)	770	548	7060
SM + 100kg/ha P	802	745	7720

Our results show that through agricultural intensification, based on biological and agro-ecological dynamics, a more stable and resilient upland farming system can be developed. The next step is to improve the fallow phase through soil-improving, nitrogen-fixing cover crops and fallow species.

The question—what species of cover crops and shrubs can be integrated into this cropping system, taking into account the characteristics of each main crop and looking at different fallow periods? — will be taken up by the class *Problem Solving in the Tropics* (INTAG/NTRES 694, fall semester 2001). Their evaluation of options will provide some specific and practical recommendations as to which species might best be integrated into an improved fallow management system around Beforona.

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