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Putting biomes to work: helping smallholder farmers restore cangahua in Ecuador

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Abstract

Most Andean farmers in Ecuador eke out a living on highly degraded cemented ash Andisols, in Kichwa called, *cangahua*, meaning «hard, sterile earth». Today, exposed cangahua covers about 200,000 ha of northern Ecuador. Composed of rhyodacite ash, rich in silica and low in alkaline metal oxides, cangahua often contains 1-3% of soil organic matter (SOM). Regarding mineral content, cangahua is rich in the nutrients that plants need for photosynthesis and growth, but these elements are primarily locked into crystals and, provided an inherent absence of soil life, unavailable to plants. Cangahua is essentially lifeless «dirt». The rehabilitation of cangahua is strategic for at least two reasons. The poorest Andean farmers eke out a living on cangahua. Secondly, provided the potential of highland Andisols to accumulate 10% or more of SOM, hundreds of thousands of hectares of exposed cangahua have a great capacity for increasing atmospheric carbon drawdown. We work with 150 pioneers of agroecology to help them fill knowledge gaps and innovate for greater productivity and more regenerative agriculture. Through ecological literacy on the formation of native forests and climax ecosystems to historical analysis of their degradation, participants are challenging common thought in industrial-era agriculture. For example, today's farmers commonly believe that plant nutrition primarily comes from the soil, when, in fact, terrestrial ecosystems are formed the other way around: plant energy primarily derives from sunlight. Through lively experiments, farmers discover that plant production of photosynthates effectively 'feeds' microbial populations that drive the formation of the «soil sponge» -- the center of the organization of terrestrial ecosystems. Through microscopy, farmers gain competence in the identification of microbial groups (e.g., bacteria, fungi, and protozoa), the function of species (endophytes, beneficials, and pests), and their impact on soil health vis-à-vis management histories and successional stages of plant-soil communities – from lifeless «dirt» to productive farming soils to climax forests. Participants manipulate functional groups, for example, by producing fungal dominant compost and applying extracts. Subsequently, participants conduct studies, and test means of increasing biodiversity favoring the maximization of photosynthesis and soil microbial development. The pioneers learn experimental design and are encouraged to conduct and share experiments. In addition, we are

working with faculty and students from the Universidad Técnica del Norte, Universidad Técnica de Cotopaxi, and Escuela Superior Politécnica de Chimborazo to evaluate soil health indicators and protocols and set up laboratories. Students provide technical backstopping to critically assess the most promising farmer experiments. Helping farmers build workable knowledge of the plant-soil biome holds great promise. A basic understanding of how plant-soil microbiomes organize and operate can help farmers´ experimenters open pathways to regenerative agriculture, enabling them to become prominent actors in climate change mitigation while securing their farm production and livelihoods.

Keywords: Ecological literacy, Farmer-led experimentation, Ecological soil management, Climate change mitigation