The Agroforestry Antidote: A remedy for South Ecuador's high rates of deforestation

University of Victoria

Michael Graeme, Department of Anthropology
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Supervised by Dr. Margo L. Matwychuk, Department of Anthropology

Introduction

"Though the problems of the world are increasingly complex, the solutions remain embarrassingly simple."
-Bill Mollison, who co-founded the field of permaculture based largely on agroforestry systems [9]

- For millennia, pre-Columbus, the forests of what is now Ecuador were cultivated in response to the complex problems faced by the first peoples of these landscapes.
- Encountering these "pristine" and "bounteous" forests, first explorers failed to perceive that it was in fact due to the innovative cultivation methods developed here that the forest itself owed much of its richness and complexity [19].
- More recently Ecuador's forests have been forcibly subject to new forms of management, ones that create more problems than they solve.

Agroforestry: generally defined as a "long-term ecological and/or economic interaction between deliberately spaced or sequentially combined woody forest perennials and agricultural plants/animals within the same productive system" [23]

- From 1990-2010, Ecuador experienced the highest rates of deforestation in all of South America; South Ecuador lost 46% of its total forest cover between 1976 and 2008 [24].
- Based largely on literary research, complemented by firsthand observations of the area carried out this past November, 2016, my research explores whether the regeneration of agroforestry practices in South Ecuador remains an "embarrassingly simple" solution for reversing these degradative trends by investigating the following:
  - The agriculture-related economic, political, and social factors driving these trends of forest degradation (Figure 1)
  - Intervention points for agroforestry practices to supplant these root factors (Figure 2)
  - And the human and environmental benefits of implementing agroforestry in the region (Figures 3 & 4)

Agriculture-related factors of forest conversion in South Ecuador

Figure 1

Land extensification: a short term land-use pattern characterized by unsustainable cultivation and pasturing practices, whereby productivity quickly declines after initial clearing of forests, leading to hastened abandonment and a subsequent search to colonize new land, while the old land remains degraded and difficult to regenerate [1][26]

Political

The Agrarian Reforms of 1964 and 1973:
- Giving the illusion that land was being redistributed to small farmers [10][7]
  - Yet the majority and most ideal land remained in the hands of elite hacienda owners [7]
  - And the "re"distribution came instead through the new colonization of forests [7]
- Combining with advances in road building technologies to open up new areas for migration and the expansion of the agricultural frontier [5][4]

Integral rural development (IRD) programs in the 1980s and 90s:
- Reducing state regulations on land markets
- Favouring neoliberal capitalist goals, rather than the needs of local communities and their environments [17][7]

Economic

The growing influence of large, globalized (increasingly neoliberal) economic forces:
- Pushing the use of Green Revolution technologies for an "economic take-off" [7]
- Gearing lands that should have been redistributed into "capitalized units of production" for urban markets and international export [7]
- Driving trends in maximizing production via monoculture plantations and treeless pastures [26]

Ramifications

Human & Ecological

- Decreases in land productivity [26]
- Exceeding of agrarian carrying capacity via extensification [4]
- Placing of income and food security in precarious position
- Continued exacerbation of wealth and land disparity—clearing of new forest used as superficial solution [7]
- Reduction of water quality (sedimentation, lack of filtration, chemicals used to combat diseases and pests) [22][3]
- Increase of flash flooding due to deforestation, burning of fields and climate change—poses risks to residences, crops, and property [14]
- Loss of habitat and diversity [26]
- Erosion and reductions in soil fertility [4]
- Decreased water-holding capacities of soil (contributions to desertification) [15]
- Alterations to watersheds [22]
- Microclimate changes and contributions to macroclimate change [10][14][16]
- Processes of extensification intruding on Podocarpus National Park which harbours 3000-4000 distinct species [26]
- Repetitive burning after clearing of forest, leading to quick abandonment of land via:
  - The bleeding of soil nutrients in long-run [19]
  - And the strengthening of the competitive ability of fire-tolerant aggressive bracken fern (inedible for cattle) [4]

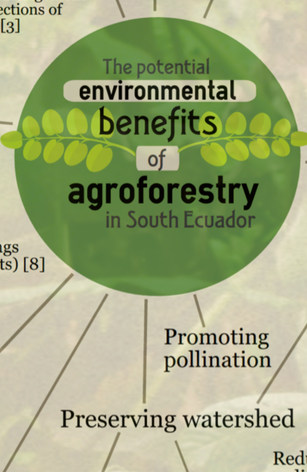
Social

Particular social practices, beliefs, and attitudes:
- Becoming promoted and forced to perpetuate unequal social structures
  - Continuing the racialized and economic marginalization of Indigenous-peasant communities [7]
  - Forcing integration of Indigenous communities into a capitalist society (e.g., the Saraguro and Shuar of South Ecuador) [7]
  - Making inaccessible or replacing knowledge and experience of sustainable land-use with modern methods [13]

Figure 3

- **Enhancing climatic buffering ability**
  - E.g., during El Niño Southern Oscillation (ENSO) years coffee production may falter by as much as 40-80% due to devastating fluctuations in precipitation, temperatures, and winds [25]
    - These events can be greatly mitigated by the protective shade trees in coffee systems [25]
- **Increasing food security**
- **Decolonizing and realizing Indigenous sovereignty**
- **Regenerating unproductive land**
- **Increasing vitality of land for future generations**
- **Improving health of watersheds**
  - Moderating water flows
  - Increasing filtration
    - Cleaner water systems
  - Decreasing contamination of agri-chemical inputs
- **Benefitting adjacent communities and cities**
  - Reducing downstream flooding from sporadic rain events and drying up of soils (desertification) by retaining water in the system [8][10][15]
- **Facilitating cultural restoration**
  - E.g., intercropping native opuntia cactus as live fencing:
    - Maintaining ancestral knowledge and skills, as well as supporting cultural identity [20]
    - Increasing arable land and reversing desertification trends [20]
    - Increasing farmer income via opuntia fruit sales [20]
- **Sustainably benefitting the rural economy**
  - Combining agroforestry production with community-scale industries for local employment [8]
- **Perennial intercropping**
  - Creating a diversified income [14]
  - Replenishing soil nutrients, increasing longevity of farmland [3]
  - Increasing resilience of crops [18]

Figure 4



- **Improving microclimates through agroforestry systems' use of trees as:**
  - Temperature covers (trees acting as shade structures during day or as shields to sinking temperatures at night) [25]
  - Windbreaks (buffering crops against fierce winds and storm events) [3][10]
- **Sequestering carbon**
  - Providing high carbon capture and storing capacity (in vegetation, soils, and biomass products) [2][14]
  - Decreasing the amount of burning of agricultural fields and pastures, preventing release of nutrients and Co2 into atmosphere [14] [19]
  - Improving soil and restoring degraded land
    - Replenishing organic matter via pruning and composting, etc.
    - Conserving soil via "no till tilling" (e.g., using chickens [see background photo], which simultaneously aid in natural pest regulation and produce natural fertilizer)
    - Promoting natural cycling of nutrients [3][14][18]
      - E.g., lowering need for chemical fertilizers via nitrogen fixation and manure [8][13]
- **Promoting pollination**
  - Increasing bird and other wildlife habitats (e.g., shade for dwellings and shade-loving plants) [8]
  - Increasing crop and tree diversity
  - Noting, however, that the degree of biodiversity of agroforestry systems is not as high as natural forests [18]
- **Preserving watershed**
  - Reducing sedimentation [3][22]
  - Protecting soil from water and wind erosion (e.g., by providing protective vegetative covering and rooting soil) [8][10][16]
  - Decreasing contamination of agri-chemical inputs [3]
  - Improving water quality
    - Bottom-up: by increasing water retention capacity [8][15]
    - Top-down: by mitigating climate change [14]
- **Combatting desertification**
  - E.g., Implementing Opuntia cactus to curtail desertification, improve humidity and capacity for water retention of soil, and preserve this native specie [20]
  - Enhancing the forested buffer around Podocarpus National Park [6]
- **Conserving biodiversity**
  - Helping buffer against disease and pest outbreaks via spatial arrangement and selections of species [3]
  - Promoting tree-crop interactions and mycorrhizal associations [14]
  - Altereres of humidity levels by staggering tree canopy densities to maintain ideal humidity levels and soil quality [25]
    - Considering, however, that humid microclimates can support pests; therefore "well-designed, multi-strata crop system[s]" are needed to reach optimum balance [3]

Image 1. "Extensification continues in South Ecuador." Michael Graeme. November, 2016. The main road south of Vilcabamba runs through Podocarpus National Park before reaching the Ecuador-Peru border. I traveled here to see firsthand how road access can impact the surrounding landscapes. This photo gives a glimpse of the extensification processes in practice, where trees are cleared and vegetation burned, releasing carbon and soil nutrients into the atmosphere, the clouds of smoke foreshadowing the soon abandonment of that land.

Image 2. "Early stage food forest growing in a clearing amongst later stages of succession." Michael Graeme. November, 2016. Having the privilege of staying on a property in the western buffer zone of Podocarpus National Park near Vilcabamba—the owner of which was experimenting with integrating agroforestry systems—I was able to go on walks under the canopy and begin to understand the relationships in the multi-strata of timber and fruit trees.

Some access points and considerations for agroforestry's intervention

Figure 2

- Renovate political institutions that inhibit agroforestry initiatives
  - Incentivize agroforestry-based regeneration of degraded and abandoned lands [10]
  - Revamp such IRD policies as the Agrarian Development Act (1994), which was "a clearly neoliberal law designed to liberalize the land market" [7]
- Move away from a macro-economic system characterized by privatization and unsustainable agriculture and ranching
  - Increase the availability of microcredits at interest rates below 6% (Ecuador's 12+% commercial credit rates prevent farmers from establishing agroforestry systems) [8][13]
  - Create local "ecological-economic development models" which use agroforestry to serve community and landscape needs [13]
  - Establish local markets in South Ecuador for agroforestry timber and local timber processing industries for further local employment already present in north and central Ecuador) [13]
- Inspire "...the individual farmer to [embrace] agroforestry [which] is crucial to the success of agroforestry projects" [8]
  - Propose systems that can increase income and food security [13]
  - Establish Demonstration farms in area to inspire the regional community
    - Present "a broad selection of species and systems" to farmers (in contrast to a standard design), allowing them to use options in line with their resources and cultural needs [8]
    - Ensure demonstrations are collaborative tools rather than unidirectional deliveries
  - Emphasize the connection between current practices and future generations—this is shown to greatly influence desire to use agroforestry [6]
- Devise a new land reform that truly reaches the root of the unequal land distribution problem
  - Push efforts forward to honour Indigenous rights to land
    - Be mindful of research [6][8][10] showing farmers are more likely to adopt agroforestry practices when working on their own land or on land that is sufficiently sizable
- Assist Indigenous groups like the Saraguros overcome barriers in realizing their agroforestry endeavours
  - Note "the richly chequered agrarian landscape of the Saraguros presents, not only aesthetically but also ecologically, a fundamentally more positive picture [of land use]" [4]
  - Pressure the government to respect and implement the demands of Indigenous movements in the Andes
    - Ensure that in this process, power inequality isn't ignored in the discussion of identity politics [7]
  - Help forge lateral alliances between farmers, community organizations, government institutions, and researchers for sharing and building knowledge and technology [6]
  - Facilitate native species cultivation strategies in order to revitalize indigenous practices [26]
- Connect reforestation and conservation efforts with farming systems
  - Grab the opportunity to preserve ecosystem integrity: "[d]espite the...2736 native tree species in Ecuador... forestation activities are almost exclusively based on exotic species" [4]
  - Consider how government-led reforestation via tree plantations have had a history of failure in Ecuador due to lack of integrating farmers and tree growing [12]
    - Highlight the key role agroforestry farmers can play, both benefiting from and assisting in successful forestation efforts
  - Achieve poverty amelioration and forest conservation simultaneously [13]
    - Note Knoke's [13] study showing possible reduction in total deforestation by 45%, while at the same time elevating farmer incomes by 65% via abandoned wasteland reconversion into agroforestry systems
    - Extend "Payments for Environmental Services" (PES) to famers employing the environmental benefits of agroforestry systems [13][21]
      - E.g., protect city watersheds via PES (water supply, filtration, securing sedimentation, etc.) [4][22]
- Provide technical assistance and information to make the adoption process easy and effective [8]
  - Inspire adoption through technological simplicity, cultural adaptability and affordability of agroforestry systems [20]

Conclusion: Is agroforestry really an "embarrassingly simple" solution to the degradative trends facing South Ecuador's forests today?

Indeed, many of the human and ecological ramifications of these trends can be seen to have their direct remedy in agroforestry systems.

But the actual process of agroforestry implementation might not be so simple:

- Effectively curbing the current trends using agroforestry techniques requires setting transformations in motion on every sphere perpetuating them, which as shown in this research are deeply entrenched in historical processes:
  - The large-scale economic pressures causing agricultural- and pastoral-induced extensification must be stemmed and replaced with incentives for sustainable, equitable development honouring community priorities
  - Political structures set up to favour a dated perception of land-use productivity and which perpetuate land inequality must be dismantled and replaced with ones that honour a vision of local economic, ecological and social longevity
  - And the social practices, beliefs, and attitudes in which extensfication-related land-use patterns are rooted call for renovation as well.

A successful agroforestry revolution calls for the work of researchers, activists, citizens, and the like from many diverse backgrounds. As a student of anthropology, I hope to carry out further research in the coupled eco-cultural restoration aspects that agroforestry systems have to offer.

Backed by further research, appropriate principles, and driven by the needs of communities, the agroforestry revolution can be a win-win transformation that will supplant the problem of high deforestation in South Ecuador while benefitting farmers, local economies, and sending an example rippling outward of Ecuador's potential for a sustainable future.

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Background image: "Tilling chickens." Michael Graeme. November, 2016.

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