



Washington
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Cultivation terracing,
indigenous ecological
knowledge and sustainable
diets in a rural indigenous
community of Ecuador

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I would like to begin by paying my respect to the Sioux, Chippewa, and Ojibwe tribes, the traditional custodians of this land where we are meeting upon today.

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I have no conflict of interest to declare

The way we see the world shapes the way we treat it. If a mountain is a deity, not a pile of ore; if a river is one of the veins of the land, not potential irrigation water; if a forest is a sacred grove, not timber; if other species are biological kin, not resources; or if the planet is our mother, not an opportunity –then we will treat each other with greater respect.

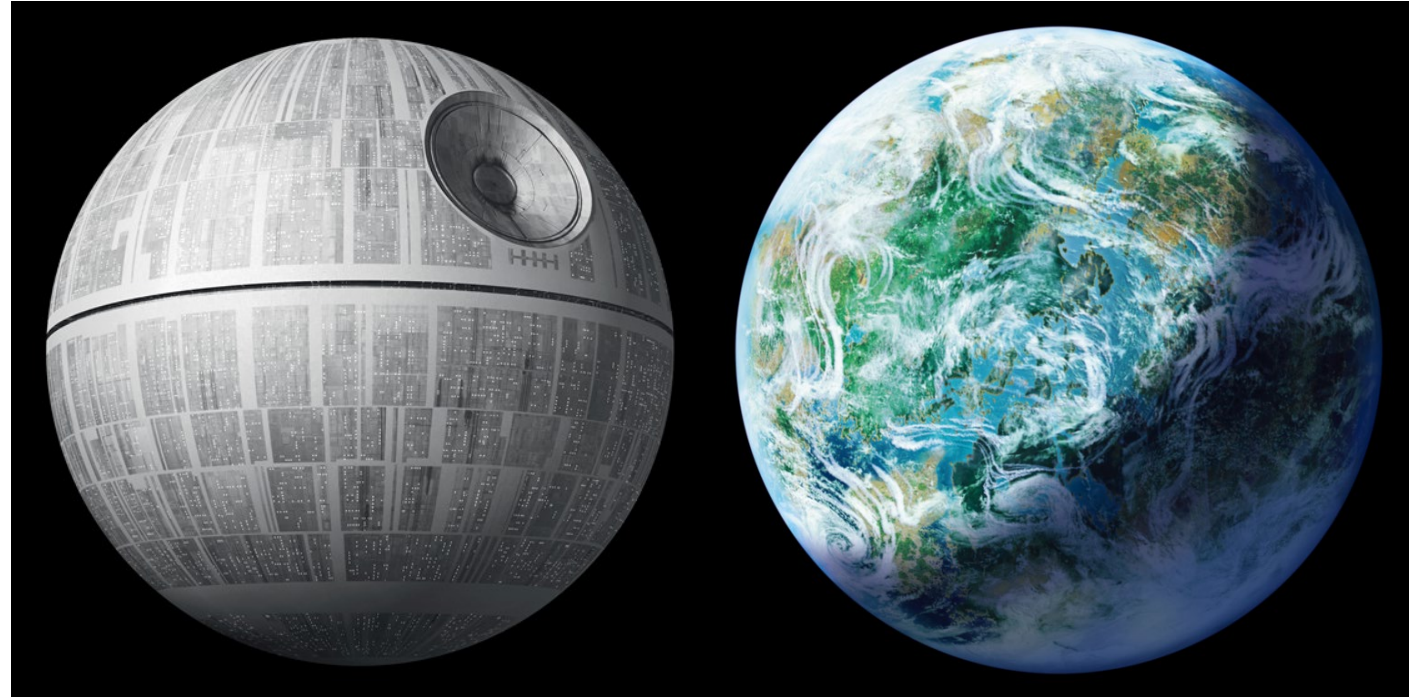
—David Suzuki

What are the boundaries and possibilities of agriculture and food production vis-à-vis Earth's capacity?

Human health¹ & Biophilia²

¹ Dan Buettner and Sam Skemp (2016). "Blue Zones: lessons from the world's longest lived;" Peter James, et al. (2016). "Exposure to greenness and mortality in a nationwide prospective cohort study of women;" Bronwyn Brew, et al. (2016); Agnes Van Den Berg, and Mariëtte HG Custers. (2011) "Gardening promotes neuroendocrine and affective restoration from stress."

² Stephen R. Kellert and Edward O. Wilson, eds. (1995). "The biophilia hypothesis;" Stephen R. Kellert (2003). "Kinship to mastery: Biophilia in human evolution and development;" Judith Heerwagen (2009). "Biophilia, health, and well-being."



Sustainable Development Goals 2015-2030

Goal 2: Zero Hunger: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Goal 13: Climate Change: Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy

Goal 14: Life Below Water: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Goal 15: Life on Land: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss]



Sustainable diets “are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate, and safe and healthy, while optimizing natural and human resources” ³

Biocultural space: long-standing, sometimes millenary, social-ecological interactions shape that are resilient, multipurpose, for maintaining cultural identity, while ethno-cultural practices catalyze ecosystems efficiency and its integrity. ⁴

³ Cristina Tirado-von (2017, p. 13). “Sustainable Diets and Healthy Planet.”

⁴ Eleanor J. Sterling, et al. (2017). “Biocultural approaches to well-being and sustainability indicators across scales.”

Biocultural spaces

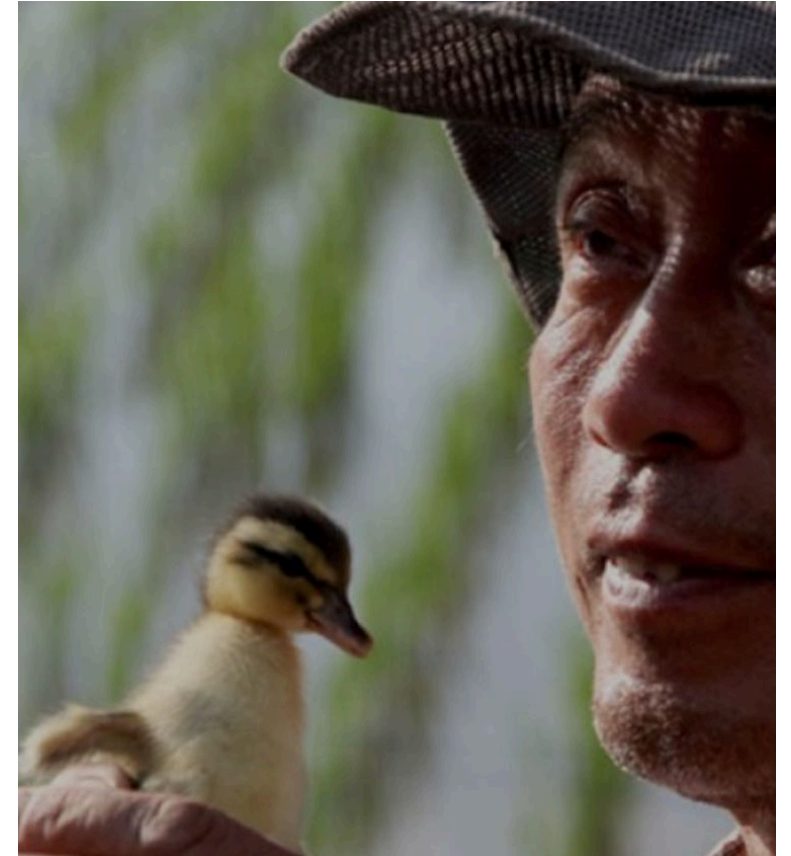
Hawaiian Limahuli gardens ⁵



Aztec Floating gardens (Chinapas) ⁶



Traditional Shizeñ system of rice (Oryza sativa) ⁷



⁵ Kawika, Winter (2014). "Limahuli Garden and Preserve" <https://ntbg.org/science/conservation/biocultural/>; Ladefoged, T. N., P. V. et al. (2009). "Opportunities and constraints for intensive agriculture in the Hawaiian archipelago prior to European contact."

⁶ Pedro Armillas (1971). "Gardens on swamps;"

⁷ David A. Andow and Kazumasa Hidaka. "Experimental natural history of sustainable agriculture: syndromes of production."

Incas' Sacred Valley ⁸



⁸ Guillet, David (1987). "Contemporary agricultural terracing in Lari, Colca Valley, Peru: Implications for theories of terrace abandonment and programs of terrace restoration."

**Research question:
What are the key
factors of an
indigenous based
agri-food system
that can promote
sustainable agri-
food systems and
sustainable diets?**

Aim 1: To characterize the Andean food system (institutions and norms, gender roles, lifestyles, dietary intake patterns, and family and community level strategies to address food challenges).

Aim 2: To characterize the Andean agroecosystems (key native species, agro-diversity, soil quality, ecological interactions, resource management and property, and agroecological system of knowledge, comprising agronomic calendars, ecology, techniques and technologies).

Aim 3: To synthesize learnings for an integrated Andean agri-food system in order to identify potential areas of intervention to improve sustainability, nutrition and food security.

Methodology ⁹

A participatory mixed-methods design:

- a) focus groups (n=39) and key informant interviews (n=7)
- b) information was triangulated with participant observations, local records, and descriptive statistics from a survey to female household heads (n=57)
- c) rural appraisal activities for agronomic calendars and yields
- d) ten sites, purposively selected, prospected with local informants to obtain a Margelef-Shannon's K Diversity Indexes
- f) a subset of five sites for agroecological parameters with MO-Dirt methods for soil health and laboratory analysis.
- g) a crossover analysis of agrobiodiversity, land-family size ratios and diet
- h) four community-based system dynamics sessions to elucidate causal-loop diagrams.

⁹ Gallegos et al (2017). "Discourse versus practice: are traditional practices and beliefs in pregnancy and childbirth included or excluded in the Ecuadorian health care system?"; Waters & Gallegos (2014). "Aging, health, and identity in Ecuador's indigenous communities"; Iannotti, et al. (2017). "Eggs in early complementary feeding and child growth: a randomized controlled trial"; Chambers (1994). "The origins and practice of participatory rural appraisal"; Oyarzun, et al. (2013). "Making sense of agrobiodiversity, diet, and intensification of smallholder family farming in the highland Andes of Ecuador"; Arango & Woodford (2016). "Danforth Plant Science Center's Monitoring Soil Health"; Hovmand (2014). "Community based system dynamics"; Kuhnlein, et al. (2006). "Documenting traditional food systems of indigenous peoples: international case studies; guidelines for procedures."

Population

Caliata (rural parish of Flores, Chimborazo province, Ecuador), about 131 miles south of country's capital.

Has 166 individuals and 57 households, self-identified as indigenous people (Kichwa, Pueblo Puruwá), with affiliation to local, regional and national indigenous movements. Dispersed, rural settlements (family smallholders), more than 9,000 feet high, with ecosystems that vary between mountain forests, bushes, paramo, and farming land.



Photos: Amaya Carrasco & Santiago Cornejo
Illustration & Design: Gabriel Ludena M

Results 1: Psychosocial dimension

- Organizational ecosystem comprised by family (ayllu), agents and super-organizations.
- Heterarchical mode of governance based on diversity, specialization and consensus.
- Customary institutions (feasts, reciprocity-based collective work [minga], and indigenous law] reinforce trust and interchange, mobilize labor-intensive tasks and food production and processing.



Photos: Amaya Carrasco



Results 1: Psychosocial dimension

- System of knowledge includes agrarian calendars, pest control, seed selection, soil restoration measures, nitrogen fixation and observation of natural keys (tulug and rain birds, height at which toads deposit their eggs, emergence of specific pollinators).
- Indigenous identity is grounded in Mother Earth (Pachamama) and traditional foods (diversity of production and diet).

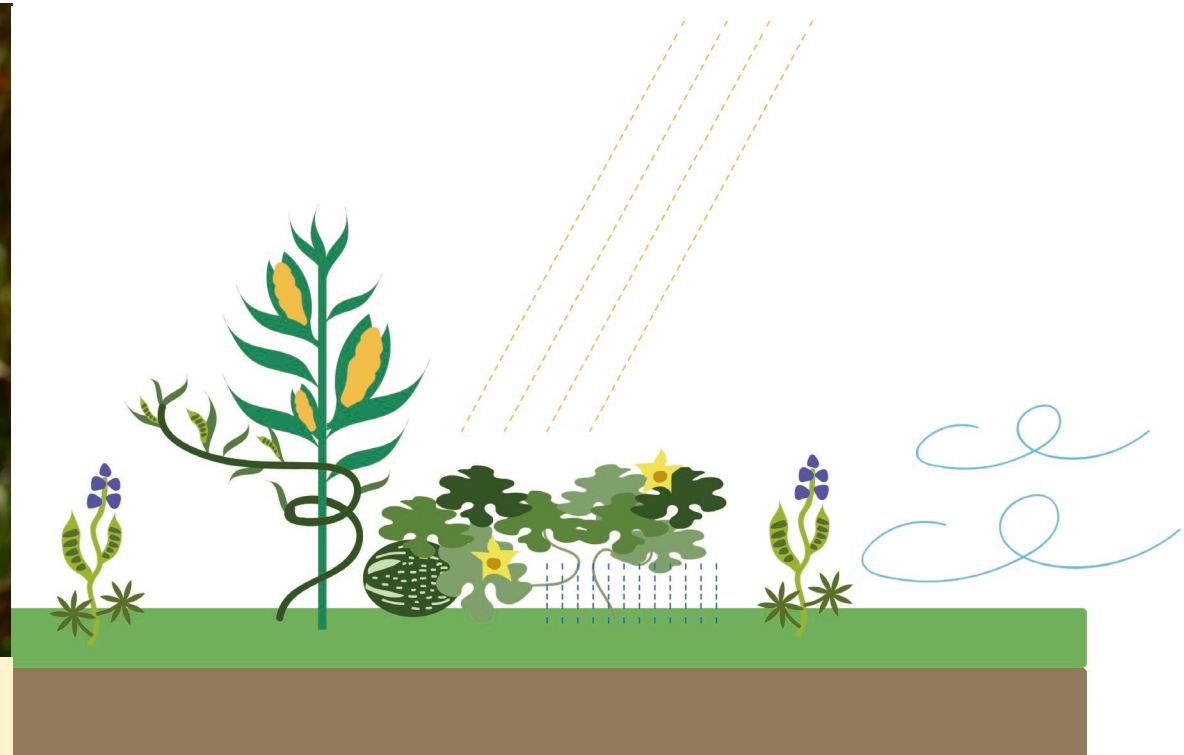


Photo: Antonio Riofrio
Illustration & Design: Gabriel Ludena M

Results 2: Agroecological dimension

- The architecture represents pre-Hispanic system of terraces, trenches, and contention walls.



Photo: Santiago Cornejo

- Agroecological functional richness based on comparative high agroecological diversity strategically and efficiently allocated (include ecological interactions and cover crops).

*Weeds, wild vegetation and wild animals were not accounted.

Table 1 Ecological richness^b

<i>Community</i>	<i>No Farms</i>	<i>F size (m2)</i>	<i>No sp/farm</i>	<i>Marg</i>
Vaqueria	13	18,567	26	2.68
Caliata	10	2,695	40	3.52

^b Comparing the highest diversity index at Oyarzun et al. 2013 and our sample

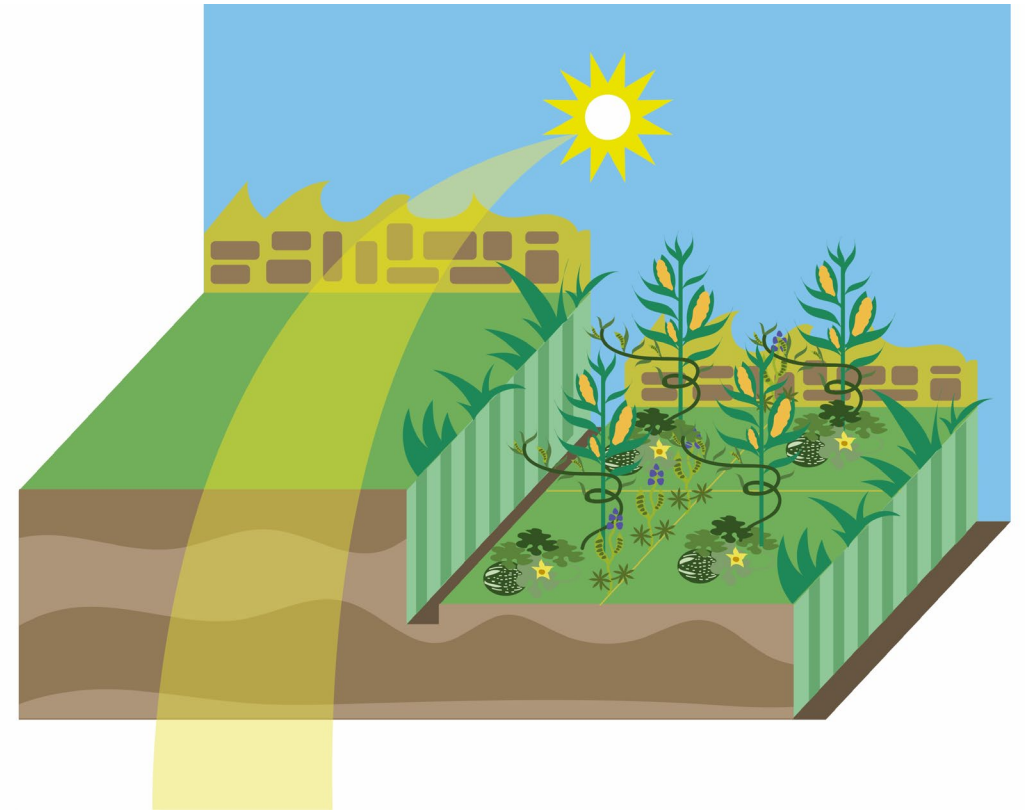
Results 2: Agroecological dimension

- The system represents reduced slopes (avgs. 7%) and healthy soils (e.g. avgs. organic matter of terraced 2.81% versus non-terraced 1.97% [values of reference: Low <1,0 | Medium 1,0 – 2,0 | High > 2,0]).
- Alignment with sunlight and energy retention traps (e.g. water sponges).
- Allows for soil harvesting.



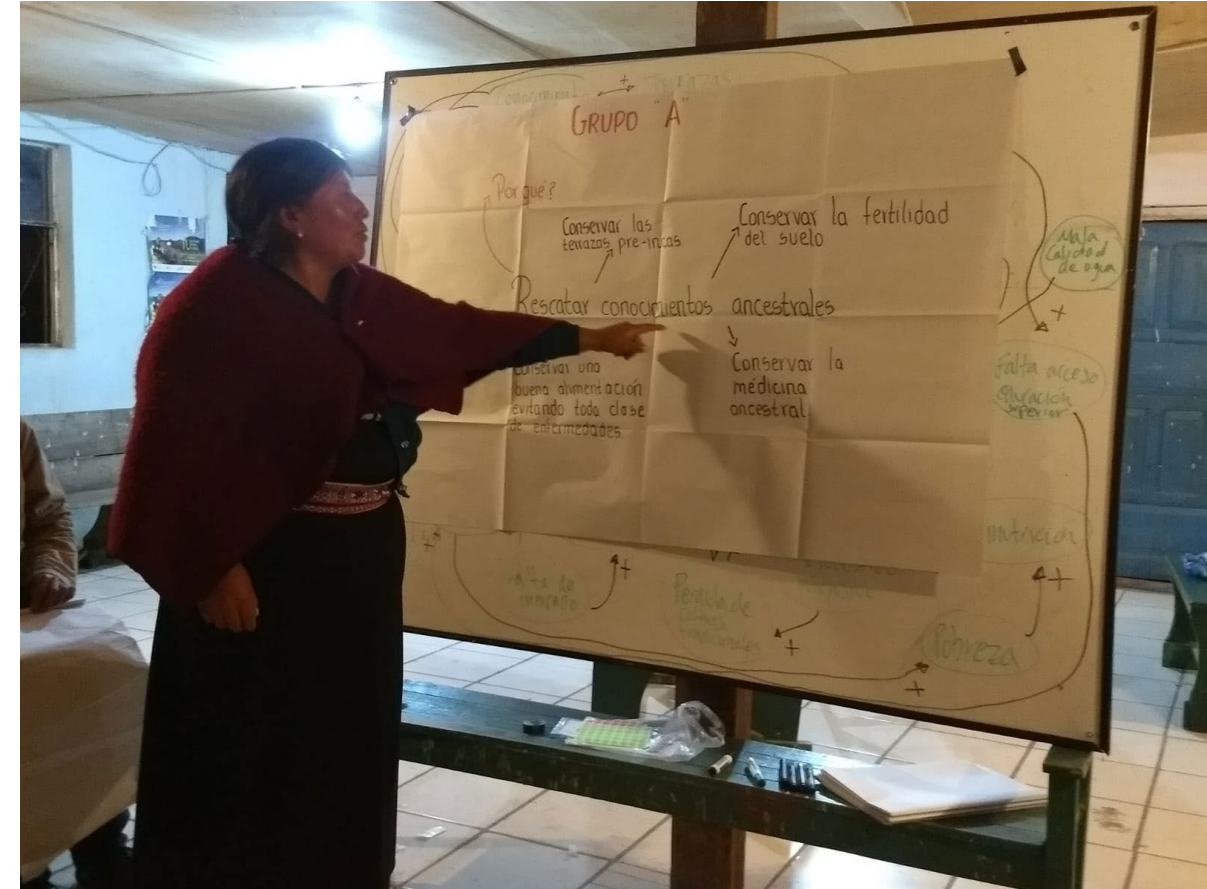
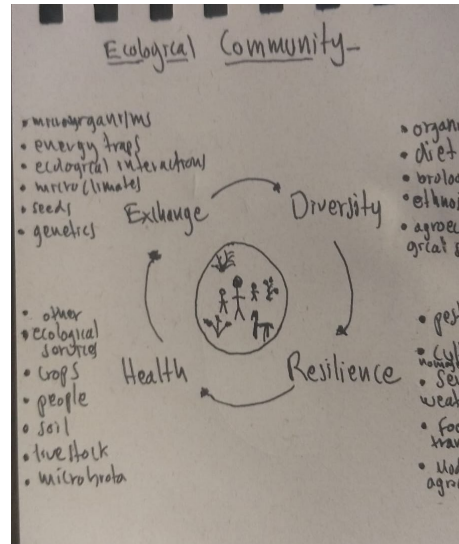
Photo: Antonio Riofrio

Illustration & Design: Gabriel Ludena M



Results 3: Strengths and threats

Combined analysis of both dimensions, including ethnographic testimonials, archeological research, and local records, suggest that the community is a remarkable biocultural space (function of biochemical processes + human behavior + time), which seems to promote sustainable crop yields through the generations while keeping the ecosystem healthy.



Results 3: Strengths and threats



Photo:
Antonio
Riofrio

However, the community is threat by overlapping phenomena, which includes historical disenfranchisement, high poverty indicators and demographic phenomena, specifically migration, an aged population and feminization of agriculture, and “modern” farming techniques.

Discussion & Conclusion

Solutions?

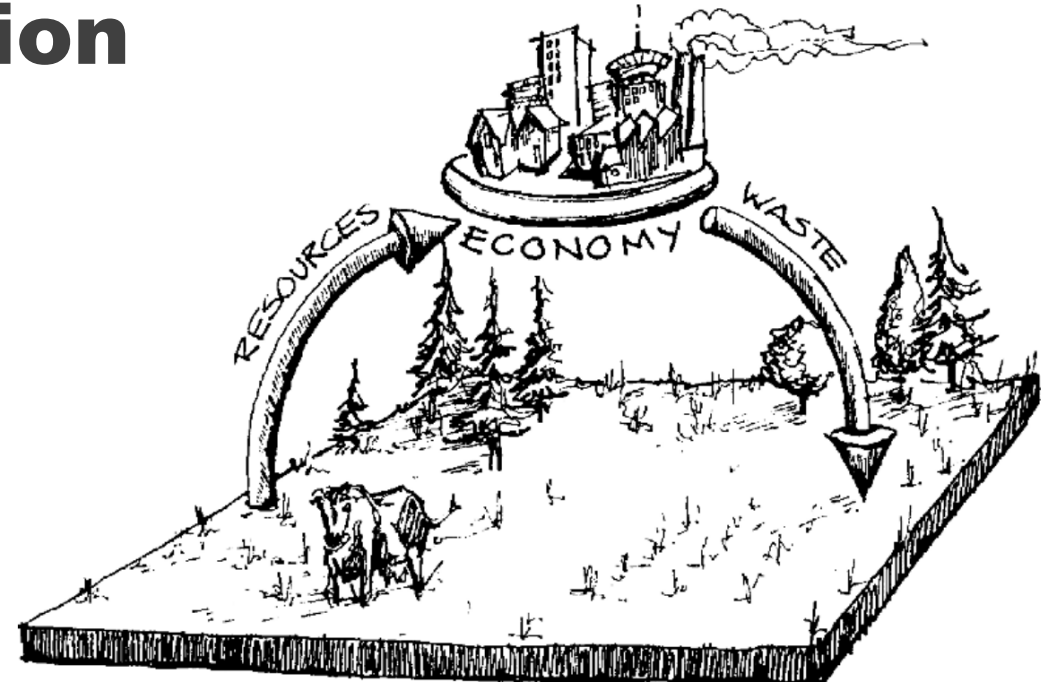
Urban centric vis-à-vis peripheric alternatives

Critical routes?

Market vis-à-vis ecosystems

Operational thinking?

Covering laws vis-à-vis free agents



¹⁰ William Rees and Mathis Wackernagel (2008, p. 541). "Urban ecological footprints: why cities cannot be sustainable—and why they are a key to sustainability."

Discussion & Conclusion

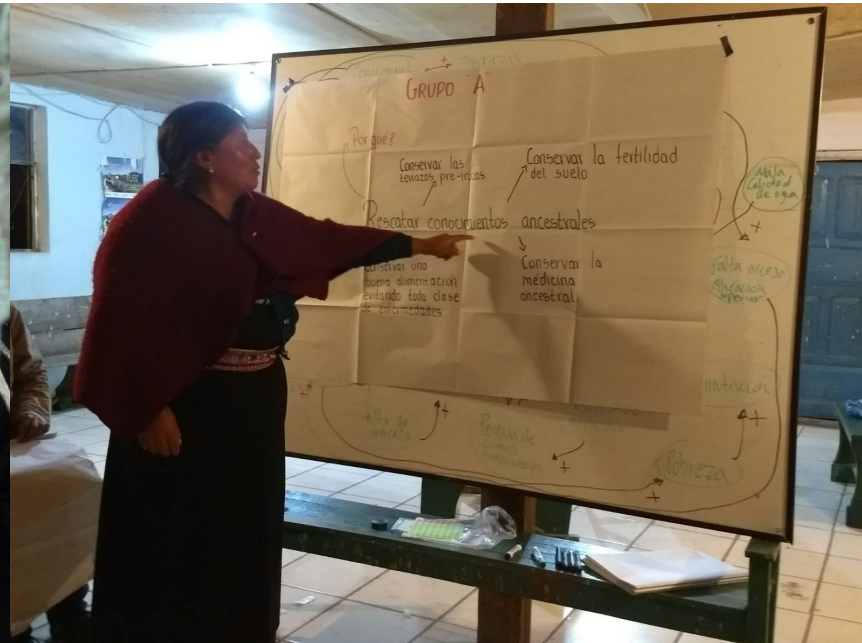
Research on biocultural systems and its conservation represents an opportunity to elucidate ideas for present and future sustainability and food security challenges.

The ideal of a single civilization for everyone implicit in the cult of progress and technique impoverishes and mutilates us. Every view of the world that becomes extinct, every culture that disappears, diminishes a possibility of life.
— Octavio Paz





Guagua Guaguapi



Thank You!
Yupaychani Kan!
Muchas gracias!