Agroecology and the COMDEKS-GEF SGP process

Miguel A Altieri
University of California, Berkeley
www.agroeco.org
www.socla.co

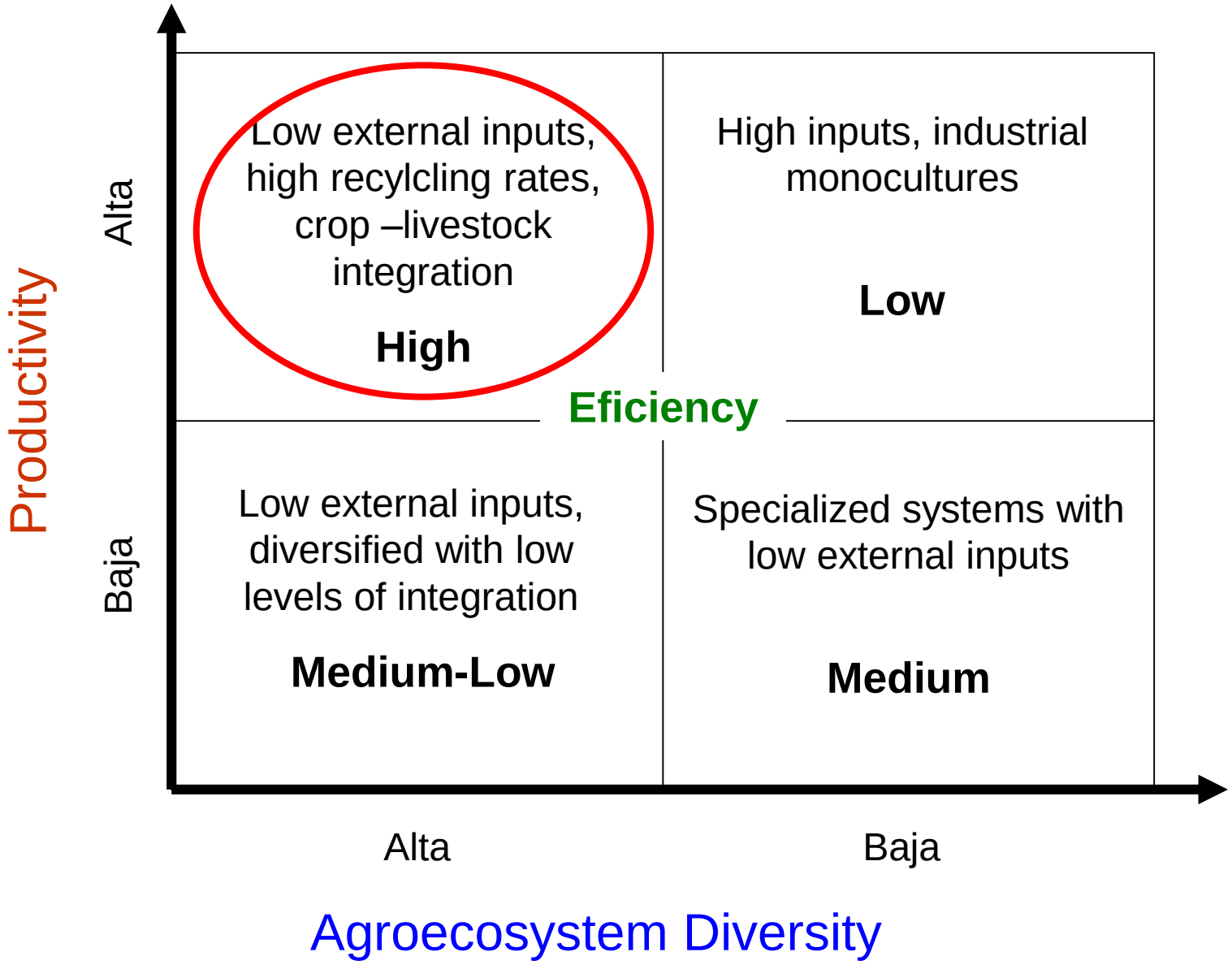
The agricultural challenge for the next decades

Food production must increase sustainably but using the same arable land base, with less petroleum, less water and nitrogen, within a scenario of climate change, social unrest and financial crisis.

This challenge cannot be met with the existing industrial agricultural model and its biotechnological derivations

Features of an agriculture for the future

- De-coupled from fossil fuel dependence
- Agroecosystems of low environmental impact, nature friendly
- Resilient to climate change and other shocks
- Multifunctional (ecosystem, social, cultural and economic services)
- Foundation of local food systems


Productivity
Alta
Baja
Low external inputs, high recylcling rates, crop –livestock integration
High
High inputs, industrial monocultures
Low
Eficiency
Low external inputs, diversified with low levels of integration
Medium-Low
Specialized systems with low external inputs
Medium
Alta
Baja
Agroecosystem Diversity

How many peasant farmers? (ETC 2009)

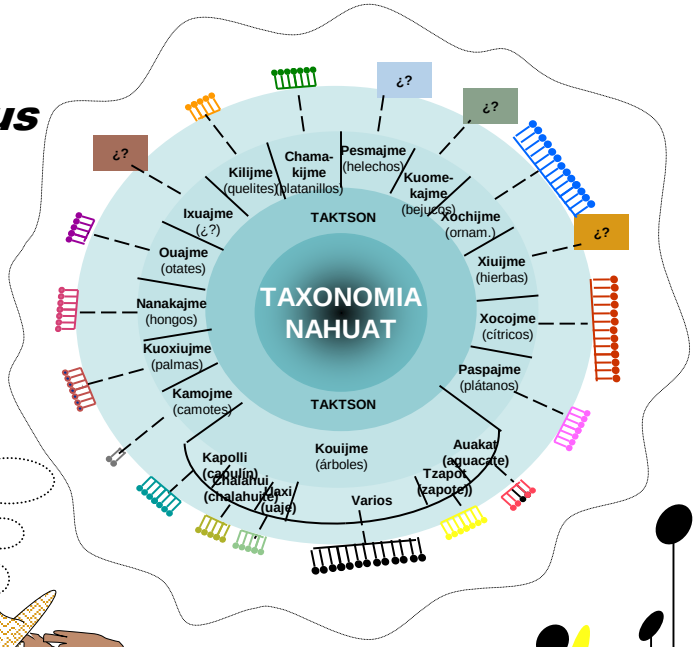
- 1, 5 billion peasant farmers
- 380 million farms
- Globally: > 90% of the world's farms are small , < 2 ha.
- 1.9 million crop varieties

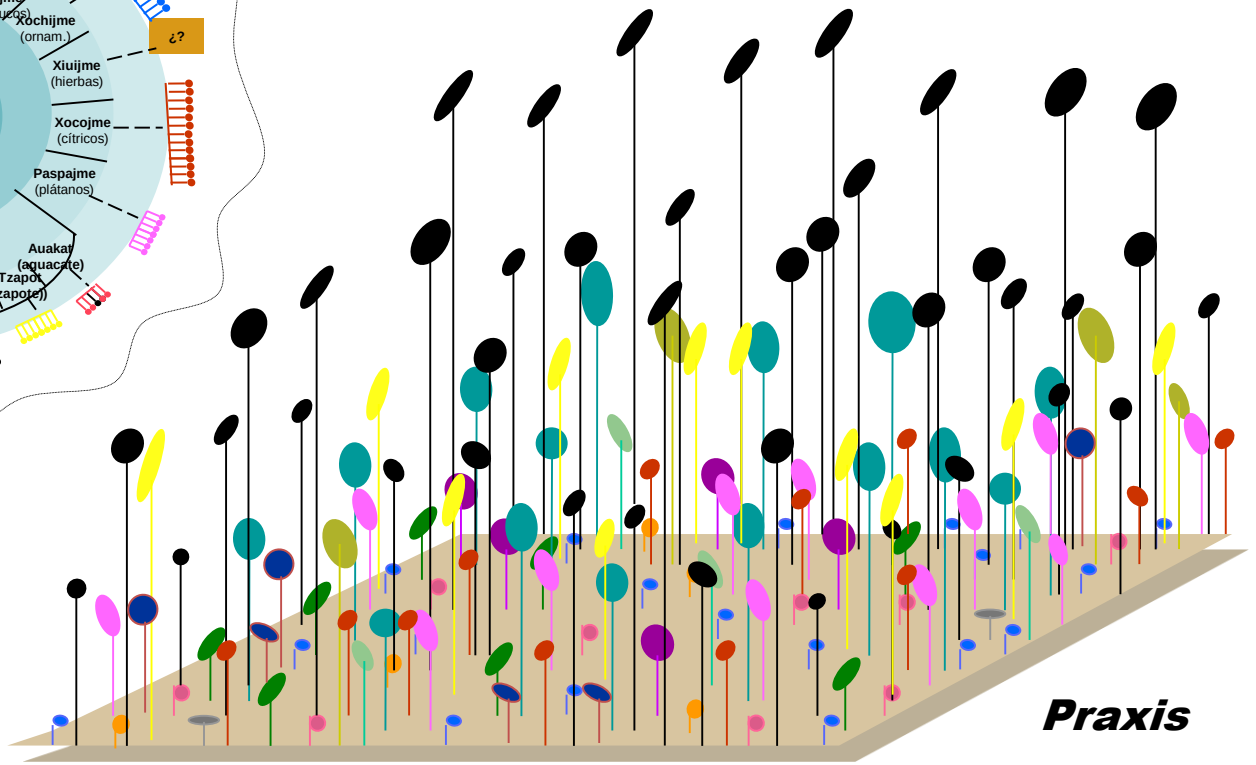
Peasants and world food

Produce 50-75% of food consumed by world population, but use :

- **25- 30% of the agricultural land**
- **30% water used in agriculture**
- **20 % fossil fuels used in agriculture.**

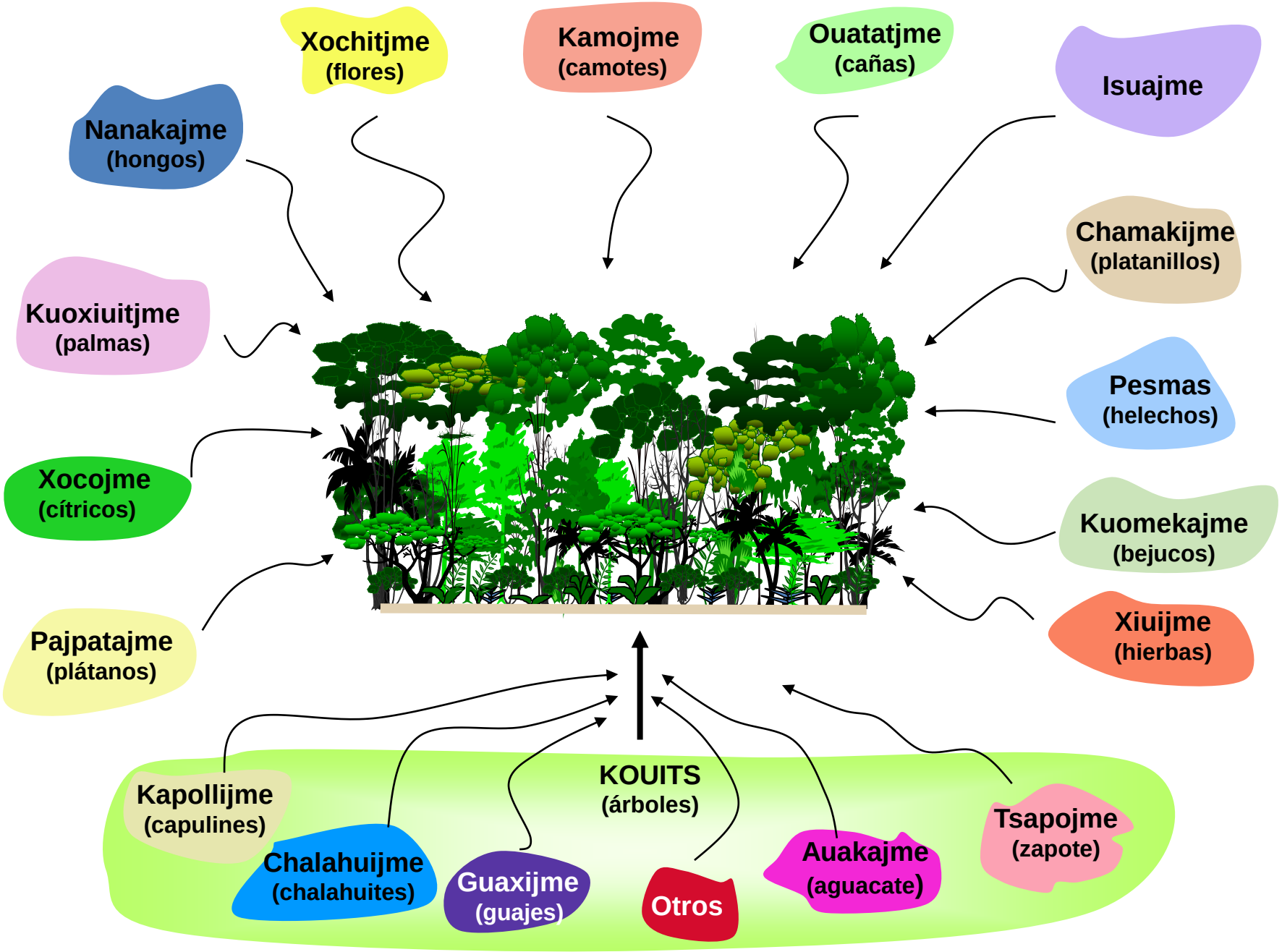
Corpus





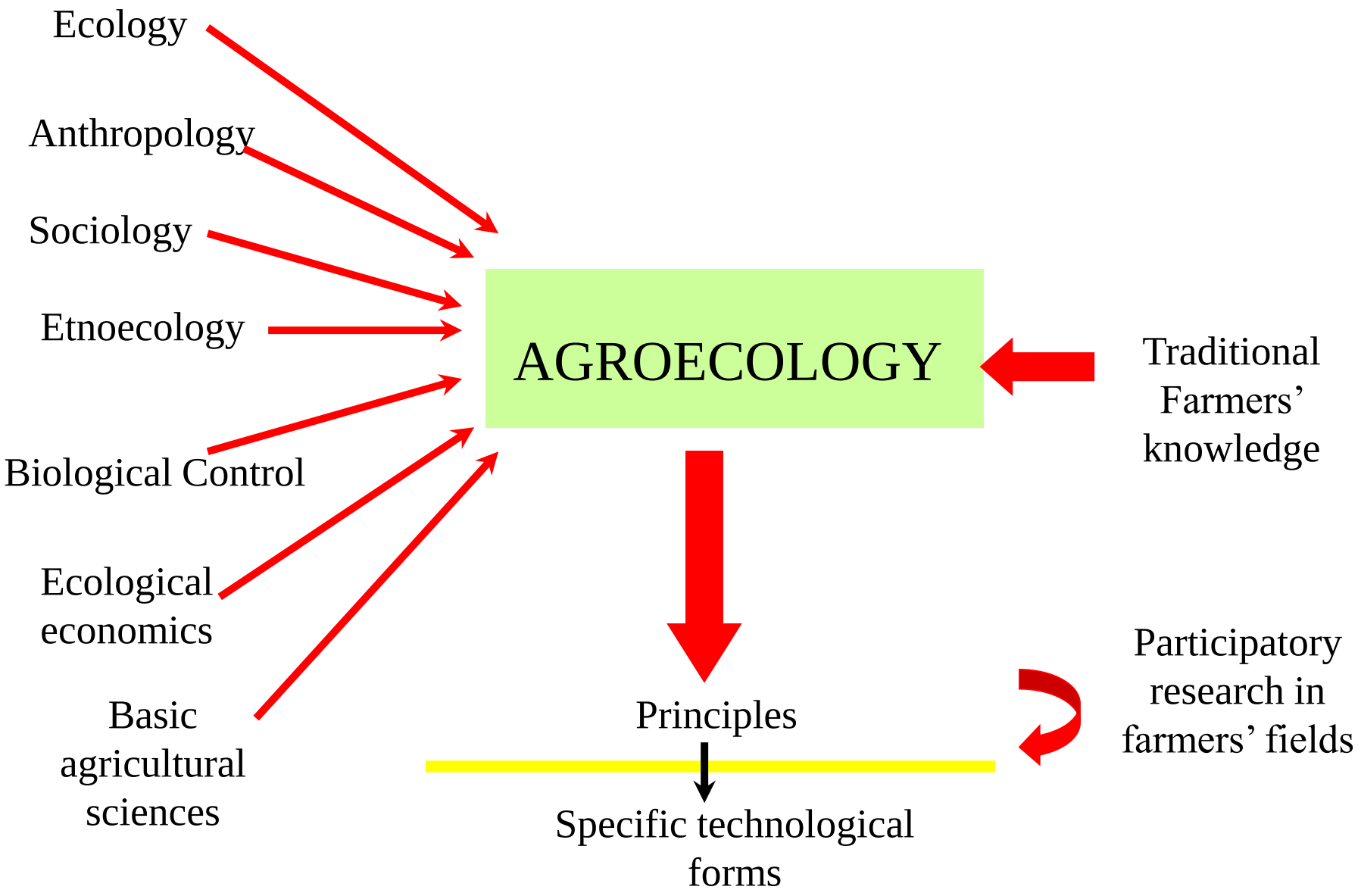
Praxis

1 Ha


Xochitjme
(flores)
Kamojme
(camotes)
Ouatatjme
(cañas)
Isuajme
Nanakajme
(hongos)
Chamakijme
(platanillos)
Kuoxiuitjme
(palmas)
Pesmas
(helechos)
Xocojme
(cítricos)
Kuomekajme
(bejucos)
Pajpatajme
(plátanos)
Xiuijme
(hierbas)
KOUITS
(árboles)
Kapollijme
(capulines)
Chalahuijme
(chalahuites)
Guaxijme
(guajes)
Otros
Auakajme
(aguacate)
Tsapojme
(zapote)

Developing and promoting agroecological innovations within country program strategies to address agroecosystem resilience in production landscapes: a guide

This guide is intended to serve as the basis for the implementation of the Innovative Agro-ecology component of the GEF Small Grants Programme in its 6th Operational phase, and to provide guidance for the agro-ecosystem outcome of the COMDEKS landscape approach. In particular, this guidance aims to enable communities to make meaningful contributions to agroecosystem resilience in selected production landscapes, by providing guidance on tools and methods that can be used to engage smallholder organizations in the participatory analysis of agroecosystem vulnerability to impacts of climate change, and other social and economic factors as well as the identification of resilience outcomes, as well as to help communities to identify agroecosystem vulnerability and resilience enhancing innovations, how to test and implement these innovations, monitor progress and analyze and evaluate results.


Ecology
Anthropology
Sociology
Etnoecology
Biological Control
Ecological economics
Basic agricultural sciences
AGROECOLOGY
Traditional Farmers' knowledge
Principles
Specific technological forms
Participatory research in farmers' fields


Species and genetic diversification in time and space at field and landscape level
Enhance soil organic matter and biological activity
Maintain landscape heterogeneity and conserve soil and water
Agroecology principles
Enhance recycling of biomass and optimize nutrient flow and availability
Prevent and contain pest and diseases through natural control mechanisms
Enhance beneficial biological interactions and synergisms

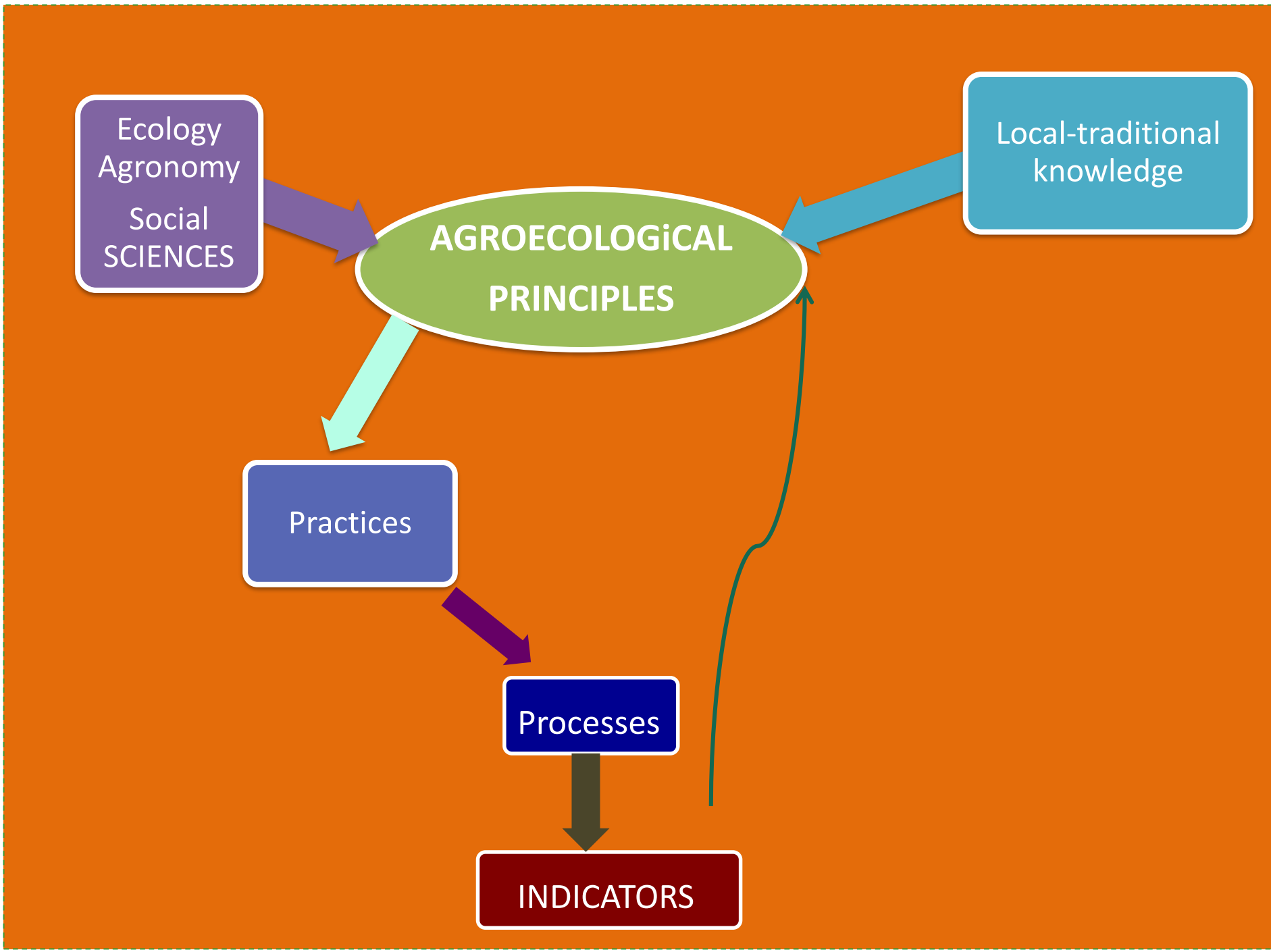
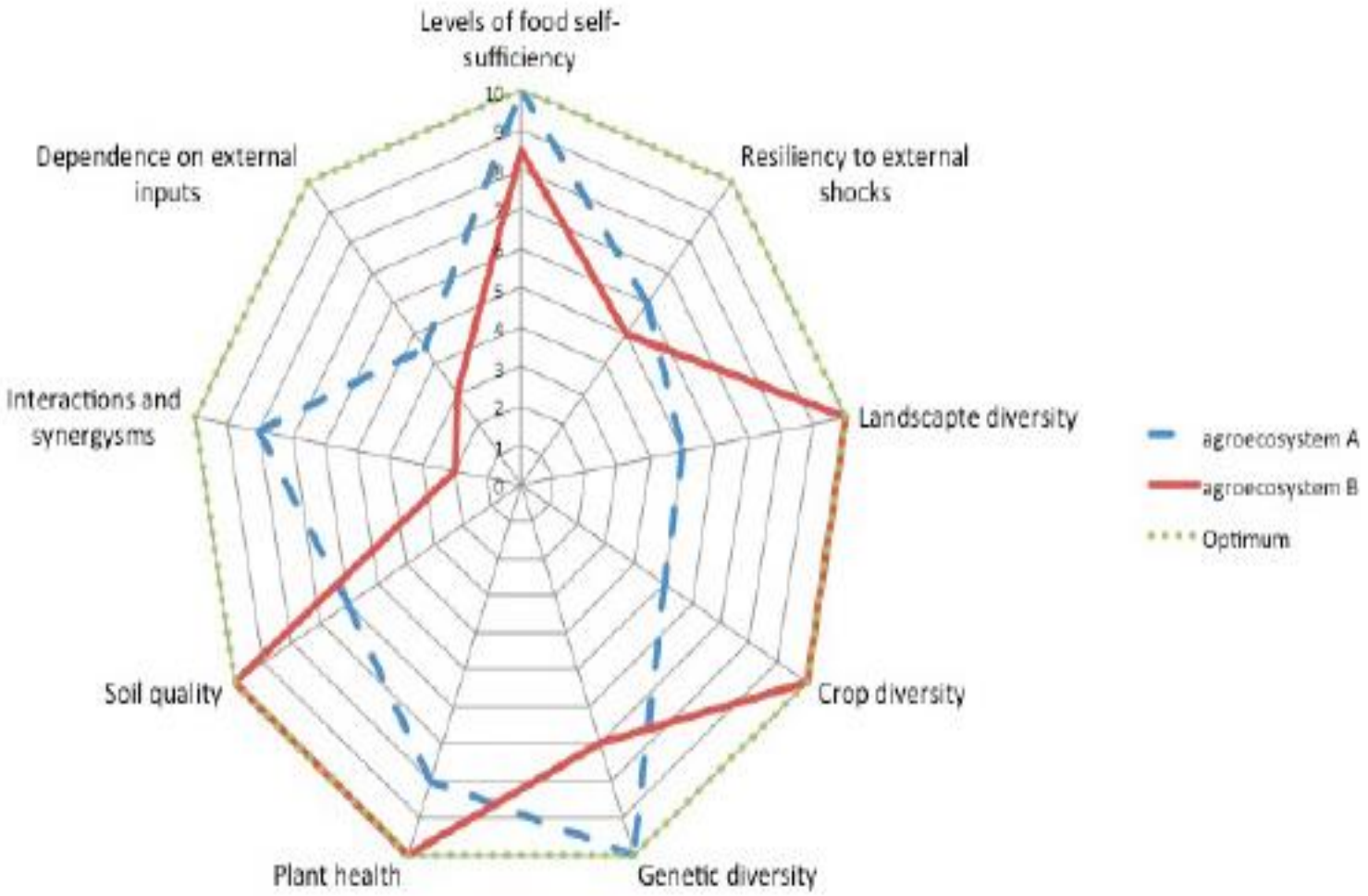

Ecology
Agronomy
Social
SCIENCES
Local-traditional knowledge
AGROECOLOGiCAL PRINCIPLES
Practices
Processes
INDICATORS

Table 7. Indicators used to asses if farms are utilizing agroecological principles in their design and management.

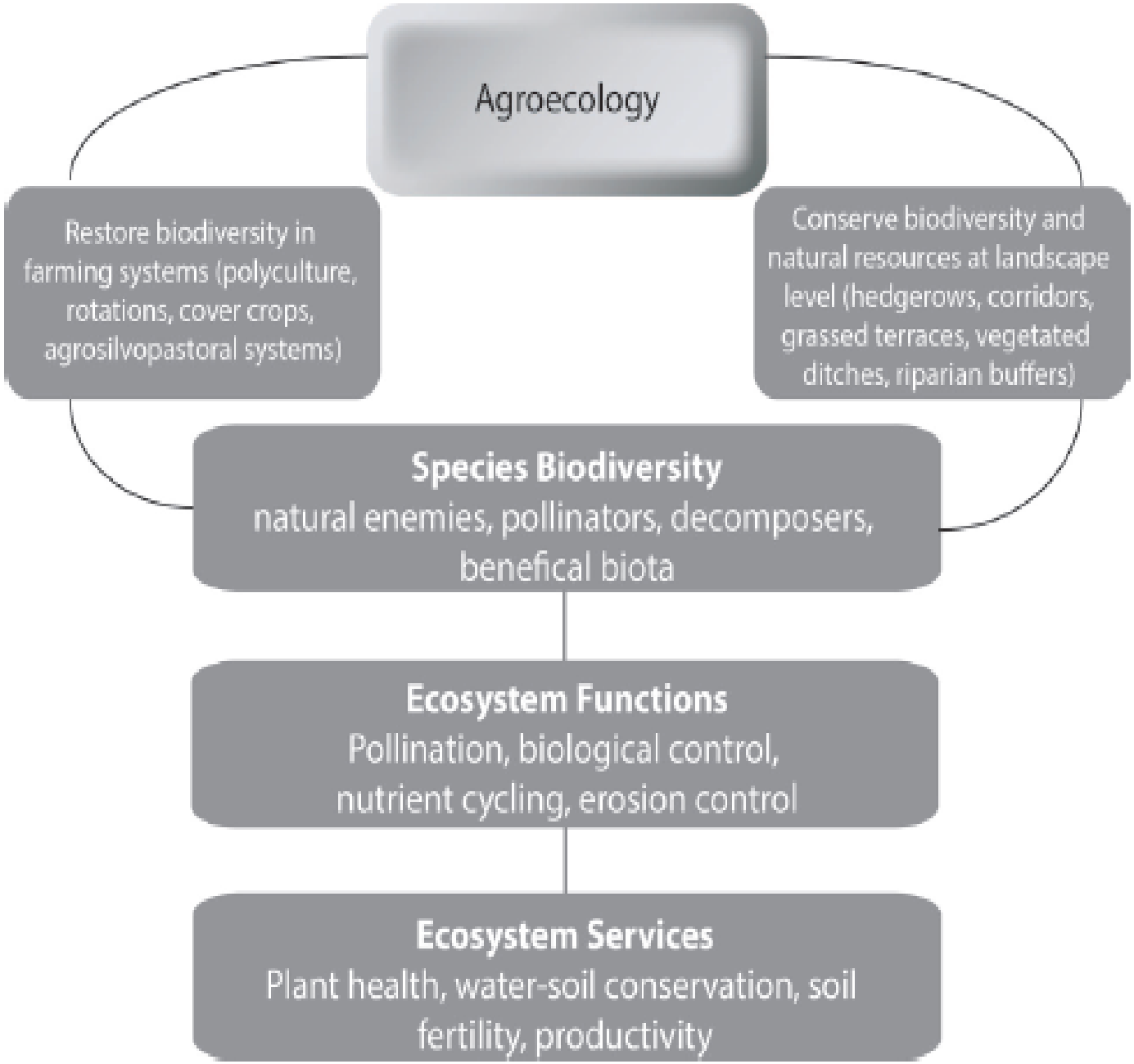
- ✓ Landscape diversity (amount and type of vegetation surrounding farm)
- ✓ On-farm crop and animal diversity (number of species)
- ✓ Genetic diversity (number of local crop varieties and/or animal races)
- ✓ Soil quality (organic matter content, structure, soil cover, infiltration, etc.)
- ✓ Sings of degradation or resource losses (soil erosion signs, deforestation, fragmentation, state of water courses, efficiency in use of water, nutrient levels, etc.)
- ✓ Plant health (presence of pests, diseases and weeds, crop damage)
- ✓ Dependence of external inputs (% of inputs originating from outside of farm)
- ✓ Levels of food self-sufficiency (% of food originating on farm)
- ✓ Interactions and bio-resources flows between farm components (recycling of crop residues and manure; effective use of biomass, complementarities between plants; level of natural pest control, etc.)
- ✓ Resilience to external disturbances (capacity to resist and recover from pests, droughts, storms, etc.)
- ✓ Use of renewable energy (windmills, biogas etc) and level of energy self-sufficiency.

Figure 11. Amoeba type diagram exhibiting indicator values for key agroecological indicators in two agroecosystems, indicating that both systems still have some indicator values below 5, suggesting that agroecological principles are not being correctly applied and thus corrections in design and practices need to be implemented.



At farm level

- ✓ Crop diversity (at least 3 species including at least one legume.)
- ✓ Genetic diversity (at least 2 varieties per crop species of which one is a local variety or landrace.)
- ✓ LER (land equivalent ratio) > 1,5. LER= Yield of crop 1 in polyculture/ Yield of crop 1 in monoculture+ Yield of crop 2 in polyculture/Yield of crop 2 in monoculture. When the LER value is higher than 1, it means the polyculture overyields. LER of 1,5 means that one hectare of polyculture produces 50% more than one hectare of monoculture.
- ✓ More than 80% of food consumed by family produced on farm. More than 9 months of household food provisions available.
- ✓ More than 70% of inputs (biomass, nutrients, water, etc.) originating on farm.
- ✓ More than 70% of the energy to run the farm originated internally (biogas, windmills, animal or human labor, etc.)
- ✓ Income (at least 30% income surplus after covering production costs). Net farm income rising.


Agroecology
Restore biodiversity in farming systems (polyculture, rotations, cover crops, agrosilvopastoral systems)
Conserve biodiversity and natural resources at landscape level (hedgerows, corridors, grassed terraces, vegetated ditches, riparian buffers)
Species Biodiversity
natural enemies, pollinators, decomposers, benefical biota
Ecosystem Functions
Pollination, biological control, nutrient cycling, erosion control
Ecosystem Services
Plant health, water-soil conservation, soil fertility, productivity

RESILIENCY

resistance to shock and capacity to recover after the shock.

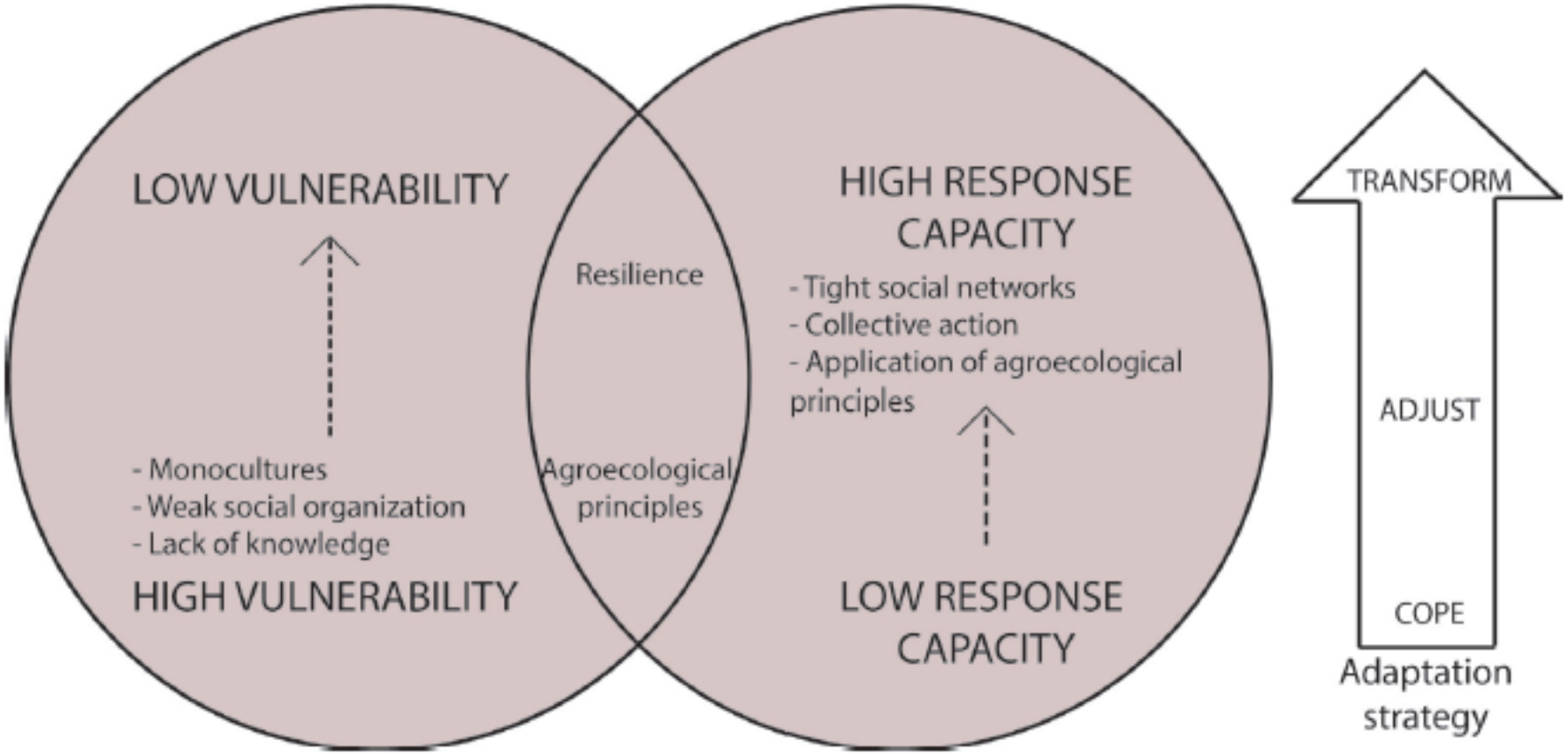
propensity of a system to maintain its organizational structure and productivity after a perturbation. This perturbation or shock can consist of frequent stressful events, cumulative or unpredictable.

SOCIO-ECOLOGICAL RESILIENCY

A resilient agroecosystem is able to still produce food after suffering the effects of a storm, hurricane or drought, or given a sudden increase in the cost of petroleum or external input scarcity

SOLIDARITY NETWORKS- to collectibly respond to external shocks

Figure 2. Resilience as the result of how effectively the enhanced reactive capacity of a community is able to reduce vulnerability and therefore climatic risk. An effective adaptation strategy evolves from coping to adjusting to climatic variability, although the ultimate goal is the transformation of the vulnerable system.

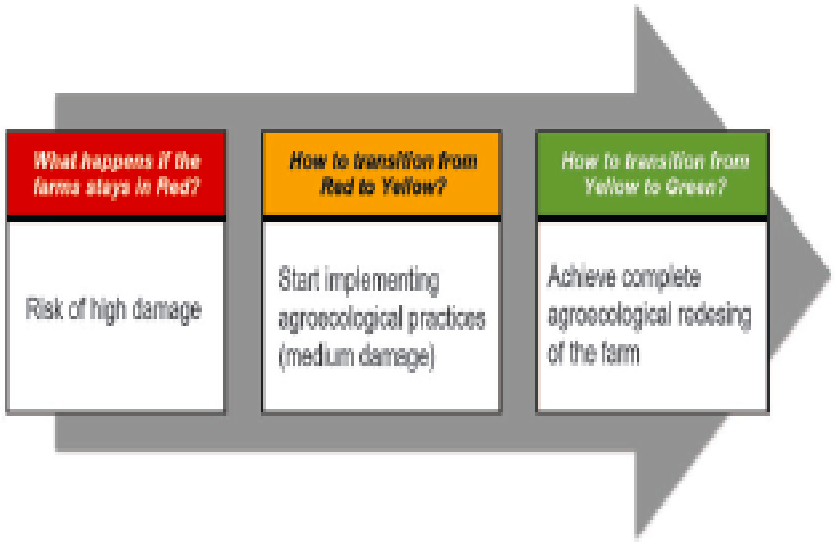


Case study 1: assessing resilience of cacao agroforestry systems to hurricanes in Central America

Goals of assessment

- How to obtain more green colors (optimal conditions) in he landscape, farmer management and soil quality categories?
- How to maintain the green colors (optimal condition) that you already have in the landscape, farmer managemetn and soil quality categories?

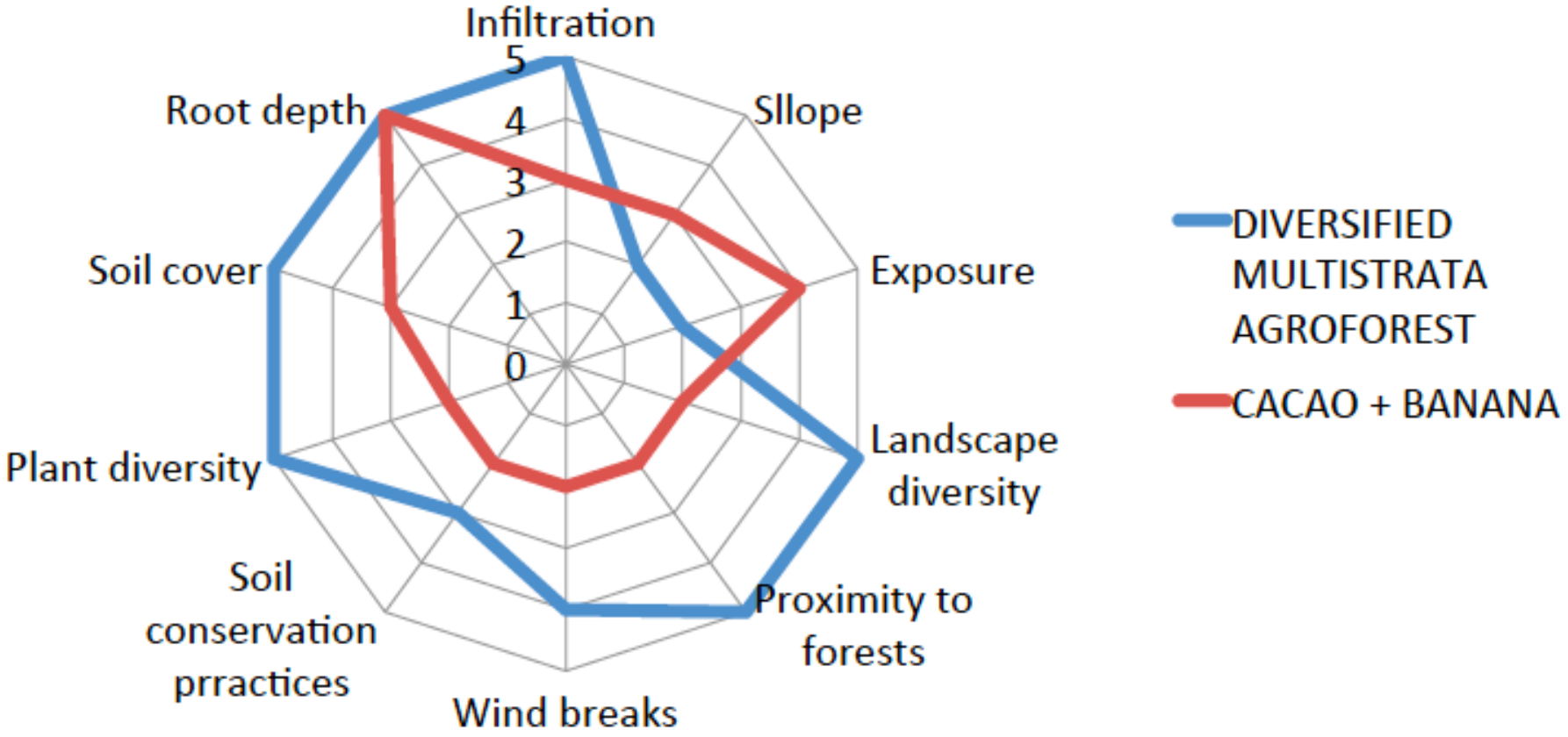
Color	Situation	Action	Numerical Value
Green	Low Vulnerability or High Resilience	Maintain the level of management / conservation (Vigilance)	5
Yellow	Medium vulnerability	Must do something to improve (caution)	3 – 4
Red	High vulnerability	Must do much to improve (Risk)	1 – 2




Case study 1: assessing resilience of cacao agroforestry systems to hurricanes in Central America

Indices of vulnerability resilience as perceived by farmers in Talamanca, Costa Rica						
	Red		Yellow		Green	
	High (4-5)		Medium (2-3)		Low (1)	
Parameter	Diversified, Rustic Cacao Agroforest **(A)**	Simplified, Rustic Cacao Agroforest **(B)**	**(A)**	**(B)**	**(A)**	**(B)**
Slope	**X**	**X**				
Exposure	**X**			**X**		
Landscape diversity		**X**			**X**	
Proximity to Forest		**X**			**X**	
Windbreaks		**X**		**X**		
Soil Practices		**X**	**X**			
Plant Diversity	**X**				**X**	
Soil Structure				**X**	**X**	
Soil Cover				**X**	**X**	
Root Depth				**X**	**X**	

Ameba Indicadores de Resiliencia en dos sistemas agroforestales



Case study 2: assessing resilience at landscape and farm level in degraded landscapes in Mixteca Alta, Mexico

TABLE 2 Description of landscape indicators

Indicator	Marginal	Acceptable	Optimal
Territorial composition	The majority of fields are producing the same crop and during the same cycle as the production system being evaluated	Surrounding the production system there are other production systems in fallow or with different crops, but no forests	Surrounding the production system there are forests and other production systems in fallow or producing different crops
Windbreaks	Without trees or windbreaks	Large trees that compete with crops, such as juniper, pine, and eucalyptus	Multiple purpose vegetation for firewood, wood, forage, and fruit
Field location	Steep slope or in risk of frequent floods	Flat to intermediate slope with some risk of flooding	Flat to intermediate slope, below native forests and without risk of flooding
Soil conservation	No border on the edges of the production system	Rock piles on the edge of the production system	Contour ditches with some slope for drainage. Distance between bunds based on slope

TABLE 3 Description of farmer management indicators

Indicator	Marginal	Acceptable	Optimal
Crop rotations	No rotation or fallow	Rotations without legumes	Yearly rotations that include legumes
Crop varieties	Less precocious varieties of seasonal maize; beans	Precocious varieties of seasonal maize; less precocious varieties of wheat (var. largo and rocomé); squash; fava	Precocious varieties of wheat (var. pelón); cajete maize, white sweet clover clover; Peas
Polyculture	Monoculture	Intermediate polyculture	Functional polyculture
Soil amendments	No application of fertilizers, composts, or manures	Synthetic fertilizer or poor quality manures	High quality composts, green manures, and animal manures
Soil cultivation	Tractor for cajete maize	Tractor for seasonal maize	Discing with tractors followed by hilling up with draft animals

TABLE 4 Description of soil quality indicators

Indicator	Marginal	Acceptable	Optimal
Spontaneous plants	Few spontaneous plants in the milpa	Intermediate number of spontaneous plants in the milpa	Excessive amount of spontaneous plants in the milpa
Soil productivity	Poor soil that is unproductive unless amended	Fragile soil with poor harvests	Good soil that does not require many amendments
Soil organic matter	Soil with little organic matter that is difficult to cultivate, does not retain humidity, or that floods	Intermediate organic matter	Soil with high organic matter that is easy to cultivate, retains moisture, and is porous
Soil depth	Rocky, shallow or thin soils that the plow does not enter and presence of gullies	Thin soil where the plow enters approximately a half forearm (codo), or approximately 10 cm, and presence of rills	Deep soil where the plow enters approximately one forearm (codo) or 25 cm and without signs of erosion
Soil texture	Clayey soil that is sticky or sandy soil that dries quickly	Gravelly soil that retains soil moisture	Loamy soils that do not flood


Por lo anterior, el CEDICAM, busca que las familias de la región desarollen capacidades que les permitan mejorar su situación productiva y al mismo tiempo cuidando su entorno ambiental.

Taller de la Parcela Feliz

Describir Categorías y Indicadores

Paisaje

- **Composición del Territorio**
  Bosques y predios en descanso y con otros cultivos.
  Sin bosques pero sí otros predios en descanso y con otros cultivos.
  Al rededor hay el mismo cultivo que el cultivo que tiene el predio ahora y en la misma temporada.
- **Vegetación y Barreras Vivas al Rededor de los Predios**
  Árboles que se usan para muchas cosas: leña, madera, forraje, sombra y frutos.
  Árboles grandes que no son buenos para los cultivos.
  Sin árboles ni arbustos o barreras vivas.

Describir Categorías y Indicadores

Manejo de Parcelas

- **Rotación de Cultivos**
  Rotan los cultivos año con año. Además, dejan descansar la tierra, dependiendo del tipo de suelo.
  Rotan maíz-trigo u otro cultivo pero no incluyen las leguminosas y no dejan descansar la tierra.
  Sin rotación o descanso: el mismo cultivo año tras año.
- **Tipos de Semilla**
  Variedades violentas de trigo; maíz de cajete; trébol blanco; y chicharro.
  Variedades violentas de maíz de temporal. Variedades menos violentas de trigo; calabaza, y haba.
  Variedades menos violentas que se tarden mas de maíz de temporal. Frijol.

Dibujar Gráficas

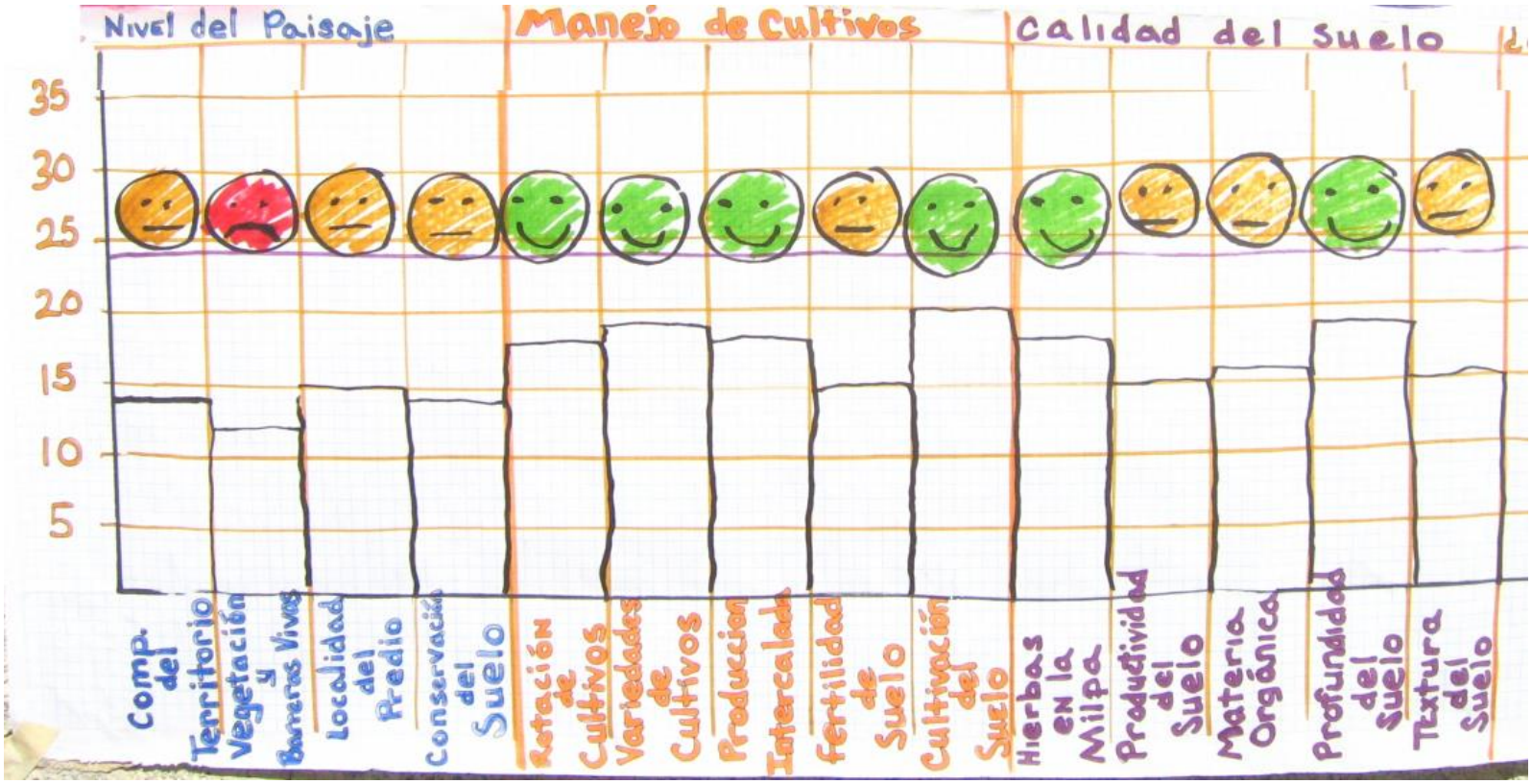
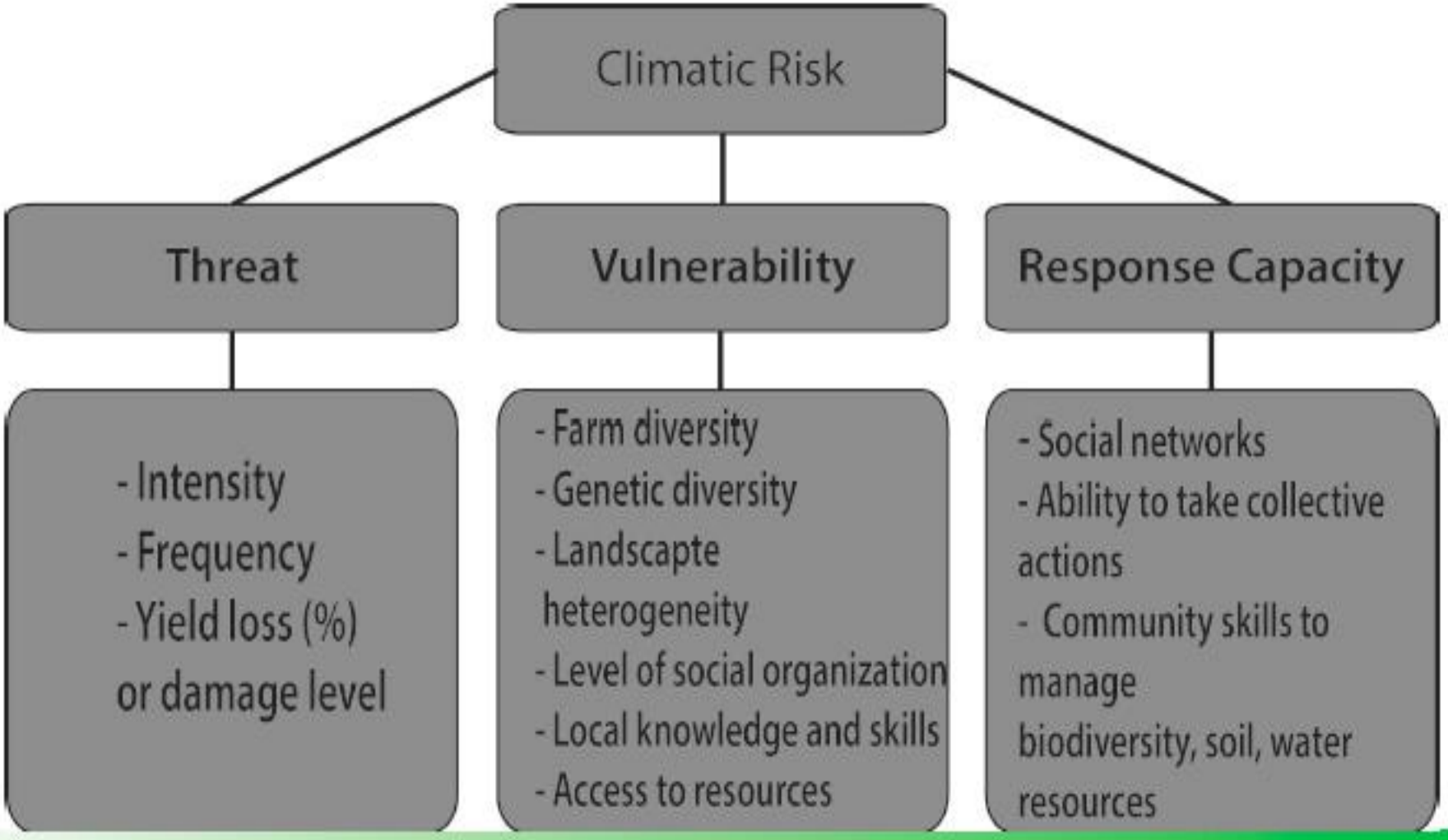


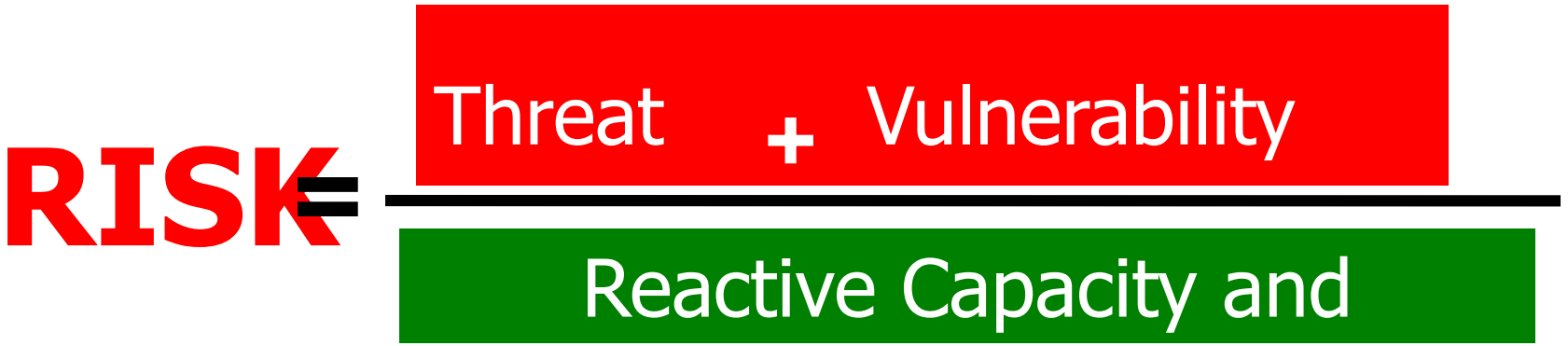
TABLE 5 Farmer strategies for dealing with climatic variability

Category	Strategies for moving towards optimal
Landscape	– Education of community members – Plant trees for fruit, fodder, etc.; protect them from animals with fences – Improve livestock management – Construct contour ditches – Maintain windbreaks
Farmer management	– Apply animal manures and composts – Relax weeding – Cultivate soil with the oxen – Respect the seasons – Harvest water
Soil quality	– Plant fruit trees and acacia – Sow green manures – Apply animal manures and composts – Avoid synthetic fertilizers

Case study 3: assessing index risk in conventional and agroecological farms in Antioquia, Colombia

Figure 1. Socioecological features that determine the vulnerability and reactive capacity of farmers to enhance the resiliency of their farms and communities to climatic threats.



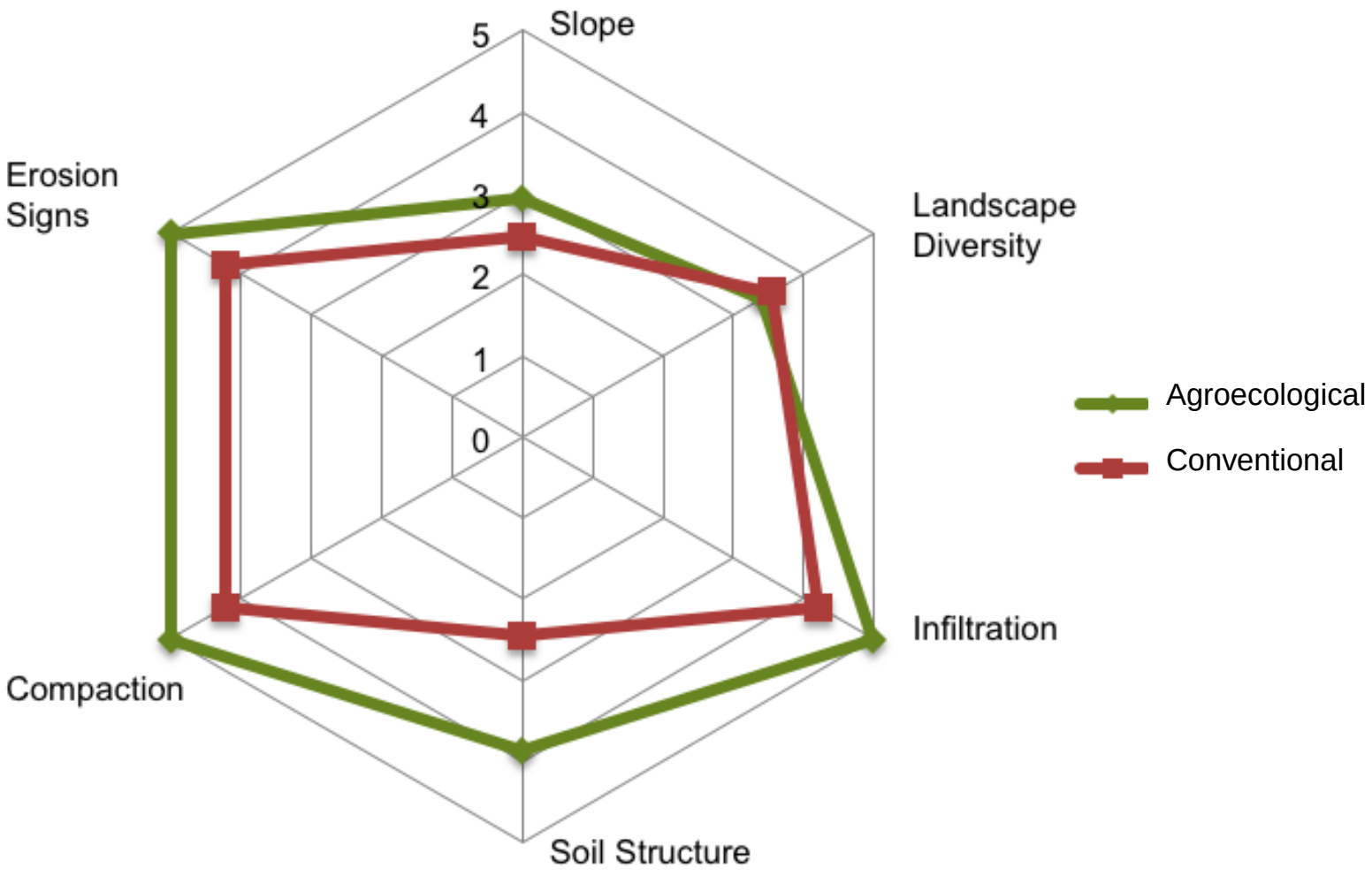

RISK
=
Threat
+
Vulnerability
Reactive Capacity and

Agroecological Management (a)

		Renaser (El Carmen)	El Jardín (San Cristóbal)	La Subienda (San Cristóbal)	Cocondo (Titiribí)
		VULNERABILITY LEVEL			
1. SLOPE	Slope	2,68%	22,90%	8,20%	58,68
2. DIVERSITY LANDSCAPE	Diversity Landscape	Medium Risk	Medium Risk	Medium Risk	Low Risk
3. SOIL´S EROSION SUSCEPTIBILITY	Infiltration	Fast (5,16 min)	Fast (9 min)	Fast (6 min)	Fast (2,8 min)
	Soil Structure	Low Density	Medium Density	Medium Density	Low Density
	Compaction	Low Risk	Low Risk	Low Risk	Low Risk
	Erosion signs	Low Risk	Low Risk	Low Risk	Low Risk

Conventional Management (c)

		Cocondo "Pasture"	Santa Ana (Fredonia)	La Rosita (San Cristóbal)
		VULNERABILITY LEVEL		
1. SLOPE	Slope	47,7	60,62	8,00%
2. DIVERSITY LANDSCAPE	Diversity Landscape	Low Risk	Medium Risk	Medium Risk
3. SOIL´S EROSION SUSCEPTIBILITY	Infiltration	Moderate (66 min)	Fast (0,5 min)	Fast (4 min)
	Soil Structure	High density	Low Density	Medium Density
	Compaction	Medium Risk	Low Risk	Low Risk
	Erosion signs	Low Risk	Medium Risk	Low Risk

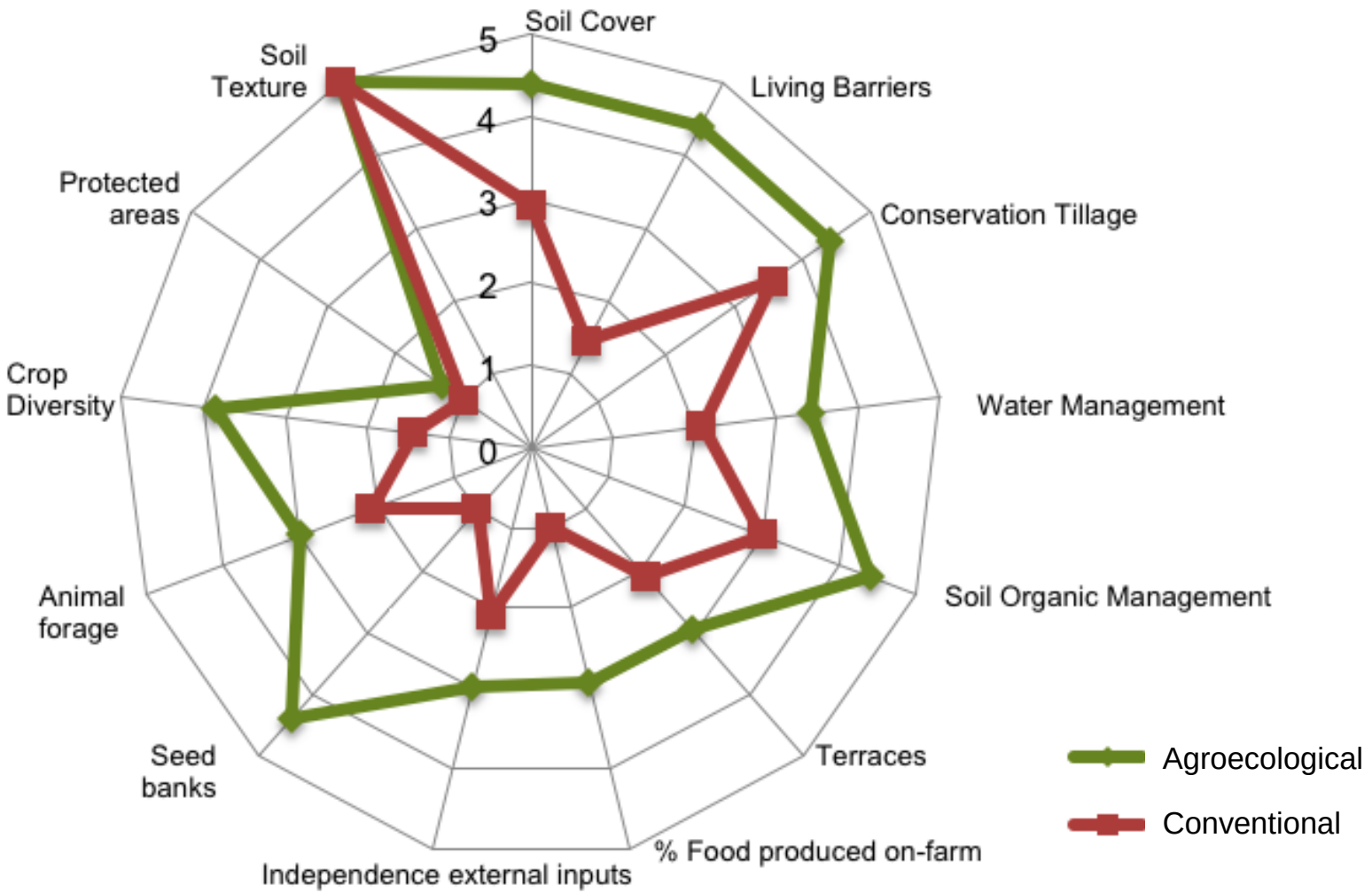

Slope
Landscape Diversity
Infiltration
Soil Structure
Compaction
Erosion Signs
5
4
3
2
1
0
Agroecological
Conventional

Agroecological Management (a)

		Renaser (El Carmen)	El Jardín (San Cristóbal)	La Subienda (San Cristóbal)	Cocondo (Titiribí)
		RESPONSE CAPACITY			
SOIL CONSERVATION PRACTICES	Soil Cover	> 50%	> 50%	10 - 50 %	> 50%
	Living Barriers	> 50%	> 50%	10 - 50 %	> 50%
	Conservation Tillage	> 50%	> 50%	10 - 50 %	> 50%
	Water Management	Medium	Medium	Medium	Alto
	Soil Organic Management	High (>3)	High (> 3)	High (> 3)	Medium (1 – 2)
	Terraces (Contour line, multiestrata system)	High (Contour line)	High (Contour line)	None	High (multiestrata)
	% Food produced on-farm	High (> 60%)	High (> 60%)	Medium (20 - 60%)	Low (<20)
	Independence from external inputs	10 - 50%	10 - 50%	10 - 50%	10 - 50%
	Seed banks	High	High	Medium	High
	Animal forage	10 - 50%	10 - 50%	10 - 50%	10 - 50%
	Crop Diversity	High (> 2)	Medium (= 2)	Medium (=2)	High (> 2)
	Protected areas within farm	< 10 %	> 30 %	< 10 %	< 10 %
	Soil Texture	Franco - Limoso	Franco - Limoso	Franco	Franco – Limoso

Conventional Management (c)

		Cocondo "Pasture"	Santa Ana (Fredonia)	La Rosita (San Cristóbal)
		RESPONSE CAPACITY		
SOIL CONSERVATION PRACTICES	Soil Cover	> 50%	> 50%	< 10%
	Living Barriers	< 10%	10 - 50 %	< 10%
	Conservation Tillage	10 - 50 %	> 50%	10 - 50 %
	Water Management	Medium	Low	Medium
	Soil Organic Management	Medium (1 – 2)	Medium (1 – 2)	Medium (1 – 2)
	Terraces (Contour line, multiestrata system)	None	Medium	Medium
	% Food produced on-farm	Low (<20)	Low (<20)	Low (<20)
	Independence from external inputs	10 - 50%	> 50%	10 - 50%
	Seed banks	Low	Low	Low
	Animal forage	10 - 50%	10 - 50%	> 50 %
	Crop Diversity	Low (monoculture)	Medium (=2)	Low (monoculture)
	Protected areas within farm	< 10 %	< 10 %	< 10 %
	Soil Texture	Franco - Limoso	Franco - Limoso	Franco - Arenoso


Soil Cover
Living Barriers
Conservation Tillage
Water Management
Soil Organic Management
Terraces
% Food produced on-farm
Independence external inputs
Seed banks
Animal forage
Crop Diversity
Protected areas
Soil Texture
5
4
3
2
1
0
Agroecological
Conventional

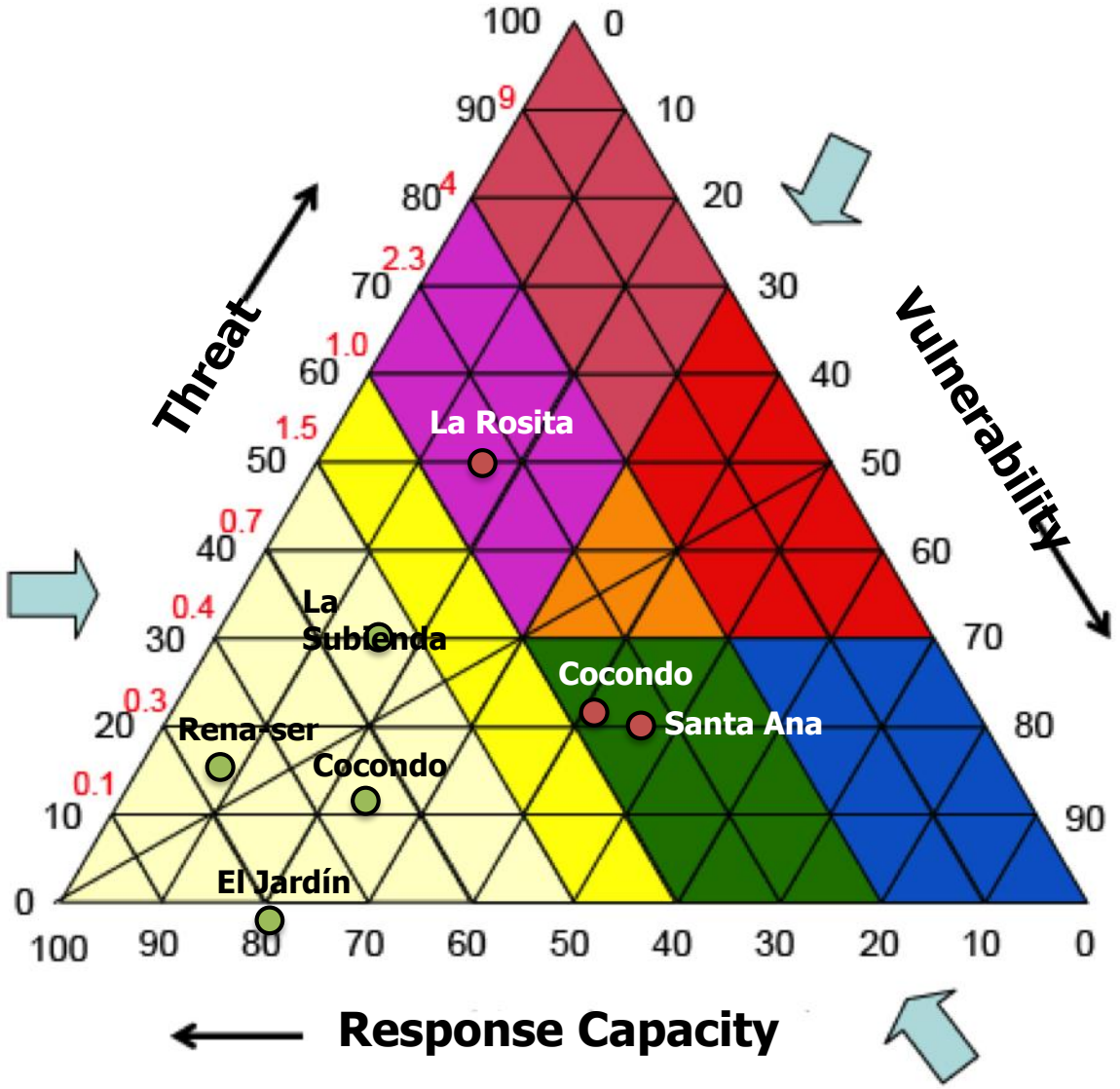
Risk Index

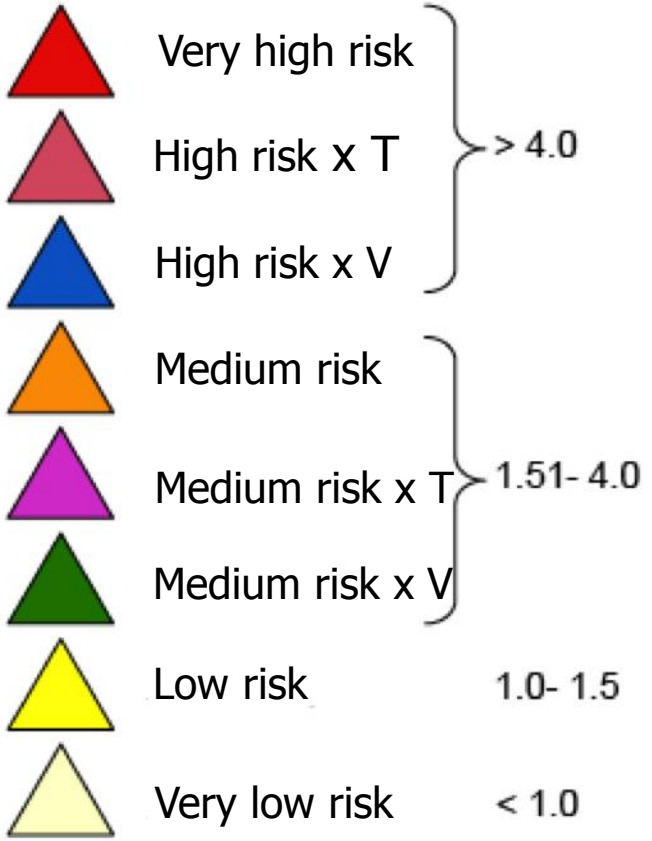
	Vulnerability	Response Capacity	Risk index
Agroecological farms			
Renaser (El Carmen)	0,408	3,926	0,103
El Jardín (San Cristóbal)	1,127	4,108	0,274
La Subienda (San Cristóbal)	0,782	2,740	0,285
Cocondo (Titiribí)	1,176	3,335	0,352
Conventional farms			
Cocondo (Pasture)	2,038	1,954	1,042
Santa Ana (Fredonia)	1,775	2,212	0,802
La Rosita (San Cristóbal)	0,782	1,726	0,453

Risk Triangle

	Vulnerability %	Response Capacity (%)
Agroecological farms		
Renaser (El Carmen)	8,16	78,52
El Jardín (San Cristóbal)	22,54	82,16
La Subienda (San Cristóbal)	15,64	54,8
Cocondo (Titiribí)	23,52	66,7
Conventional farms		
Cocondo (Pasture)	40,76	39,08
Santa Ana (Fredonia)	35,5	44,24
La Rosita (San Cristóbal)	15,64	34,52

Risk triangle





Case study 4: Assessing impacts of Ecological restoration in a rural community "El Dobio, Colombia"

Principles of ecological landscape restoration

- ✓ Identify the threats and causes of degradation.
- ✓ Stop degrading forces (keep cattle out, prevent fires, etc.)
- ✓ Reintroduce plant species as needed.
- ✓ Restoration techniques include practical techniques, such as agro-forestry, enrichment planting, and natural regeneration at a landscape scale.
- ✓ Strategically locate vegetation necessary to achieve a set of functions such as habitat for wildlife, soil stabilization, provision of fuel or building materials for local communities.
- ✓ Protect area from further degradation (soil conservation practices, water harvesting, etc.) and use adaptive management practices.
- ✓ Monitor progress of restoration using performance indicators or reference ecosystems

At landscape level:

- ✓ More than 70% of land covered by vegetation.
- ✓ No more than 25% of land area showing signs of degradation (erosion rills, deforestation, fragmentation, overgrazing, etc.)
- ✓ At least 50% of the land area using improved agroecological practices.
- ✓ Noticeable presence of hedgerows, corridors, riparian forests, no less than 50% of such features protected.
- ✓ At least 50% of forest fragments protected excluding cattle access.
- ✓ No less than 50% water courses protected from contamination and conserving springs.

1992

2001

2014

2016

Análisis comparativo en 23 años de proceso

Aspectos	1993	2016
Conservación	- Bosques fragmentados - Pérdida de biodiversidad	- Fragmentos de bosque conectados y enriquecidos con especies de la sucesión tardía - Reservas naturales de la sociedad civil - Propiedad de la zona productora de agua
Agua para consumo	Oferta insuficiente para 25 familias	Oferta suficiente para 75 familias
Sistema de conducción de agua	Redes individuales	5 bocatomas, redes apropiadas de conducción y control en las viviendas
Calidad de agua	Alta sedimentación y vertimiento de materia orgánica	Baja sedimentación, descontaminación productiva y filtración lenta
Uso del agua	Desperdicio e impacto negativo de la ganadería	Uso racional, protección del corredor ribereño, bebederos sustitutos , cosecha de aguas lluvias y sistemas de almacenamiento

Análisis comparativo en 23 años de proceso

Aspectos	1993	2016
Producción agropecuaria	- Monocultivo - Dependencia de insumos externos - Impacto ambiental negativo - Pérdida de la soberanía alimentaria.	- Sistemas agroforestales - Uso racional del suelo, agua y biodiversidad - Planificación predial - Seguridad alimentaria
Social	Baja participación Desconocimiento de temas ambientales y de producción amigable con el ambiente	Tres organizaciones comunitarias, investigación participativa (CIPAV), trabajo comunitario en restauración ecológica y la reconversión productiva, intercambio de experiencias (talleres, giras y capacitación) Capacidad local de gestión (proyectos), concesión de agua a diez años, aporte económico voluntario de los usuarios para pago de impuestos, concesión y manejo Empoderamiento y arraigo por la tierra y la cultura campesina. Cohesión comunitaria que impide la entrada de factores externos negativos

Table 2. Socio-ecological features of Resilient Farming Systems and Communities

✓ High levels of biodiversity and species redundancy
✓ High connectivity and complementarity between farm components
✓ High spatial and temporal heterogeneity at the farm and landscape level
✓ High levels of autonomy and independence from exogenous controls
✓ Socially self organized conforming configurations based on needs and aspirations
✓ Reflective people that anticipate and plan for change
✓ High levels of cooperation and exchange
✓ Community honors legacy and use traditional knowledge and practices as well as local germplasm
✓ Human capital developed and able of mobilizing resources through social networks

Synergies with SOCLA (www.socla.co)

- Special workshop SGP-COMDEKS in Latin American Congress of Agroecology, September, Brasilia
- SGP participants take various courses offered by SOCLA in Brasil and Colombia in 2017
- SOCLA team collaborates with various country programs with special agroecology training and resilience assessment initiatives.
- Organize south-south exchanges