GLOBAL AGENDA FOR SUSTAINABLE LIVESTOCK
5TH MULTI-STAKEHOLDER PLATFORM (MSP) MEETING
7 - 10 OCTOBER 2014, CALI, COLOMBIA

Sustainable livestock production models: Intensive silvopastoral systems – ISS – in Latin America

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CIPAV, *Fundación Produce Michoacán, México

Few animal species were domesticated before the European invasion of the Americas: the Andean camelids (alpaca, llama), guinea pig, musk duck and turkey.

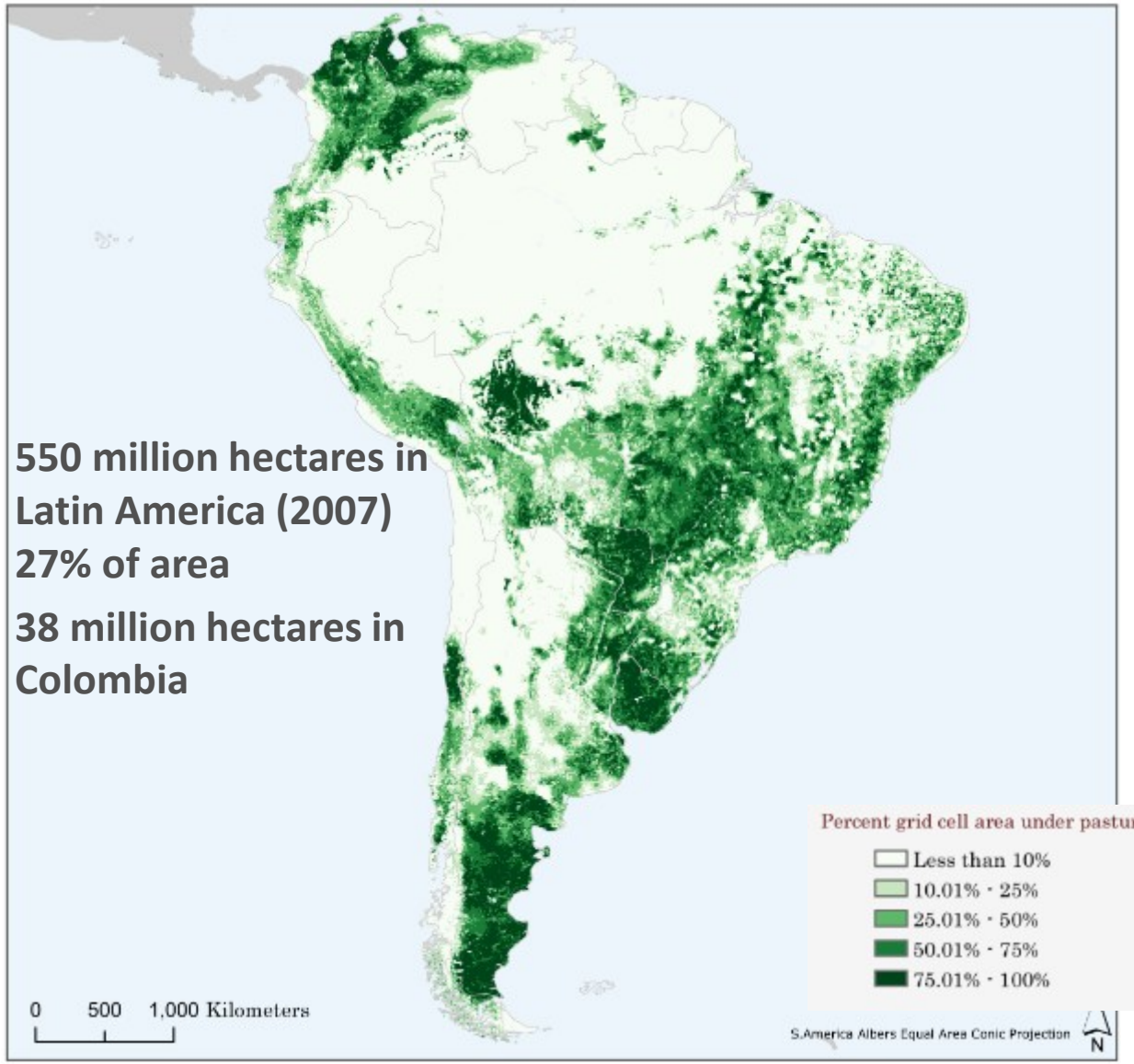
Llama *Lama glama* L.
artiodactyl of the Camelidae family;
6000 to 8000 years of domestication in Upper Peru

Guinea pig o cuia *Cavia porcellus* L.
8000 years of domestication in the Andes.

Turkey o Guajolote *Meleagris gallipavo* L.,
8000 years of domestication in Mexico

Animals brought by the Spanish and Portuguese conquerors forever transformed the Americas.

Pastures in South America

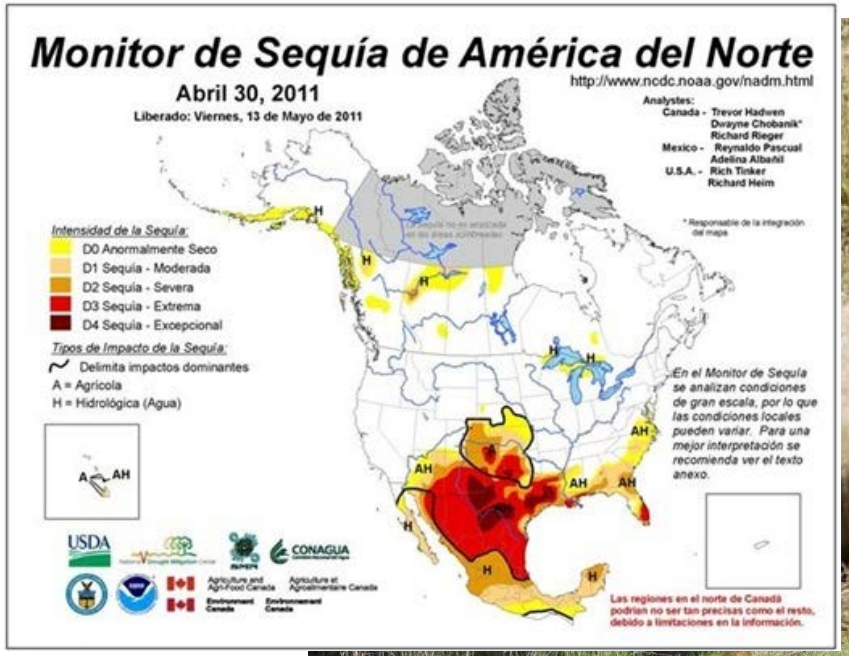


http://sedac.ciesin.columbia.edu/data/set/aglands-pastures-2000/maps


Soil losses of 30-40 ton ha-1 yr-1 are common throughout Latin America.
FAO, 2010


The Climate Change in Latin America

Mexico: Atypical drought and frost 2012



Argentina: Strong frost 2013

2014 drought in Colombia

Losses for the Livestock Sector

Weight loss of animals: US$ 2.65 millions

Decreased milk production: USS 19 millions

Loss of fertility in cows: US$ 59.5 millions

Soil and pasture degradation: US$ 32 millions

JF Lafaurie FEDEGAN 2014

Environmental transformation of livestock production: a priority for Latin America

Cattle production needs to shift from its current path of degradation of the natural and social capitals, onto one which generates goods (milk, meat, and timber) while maintaining some ecosystem attributes and services.

This change should incorporate 5 agroecological principles:

1. Increasing plant biomass (trees, shrubs and pasture)
2. Curbing soil degradation and promoting its recovery
3. Protecting water sources and using them rationally
4. Increasing animal productivity on a per hectare basis.
5. Conserving biodiversity

El Porvenir, Cesar. Colombia. Luis Solarte 2012

Intensive silvopastoral system ISPS

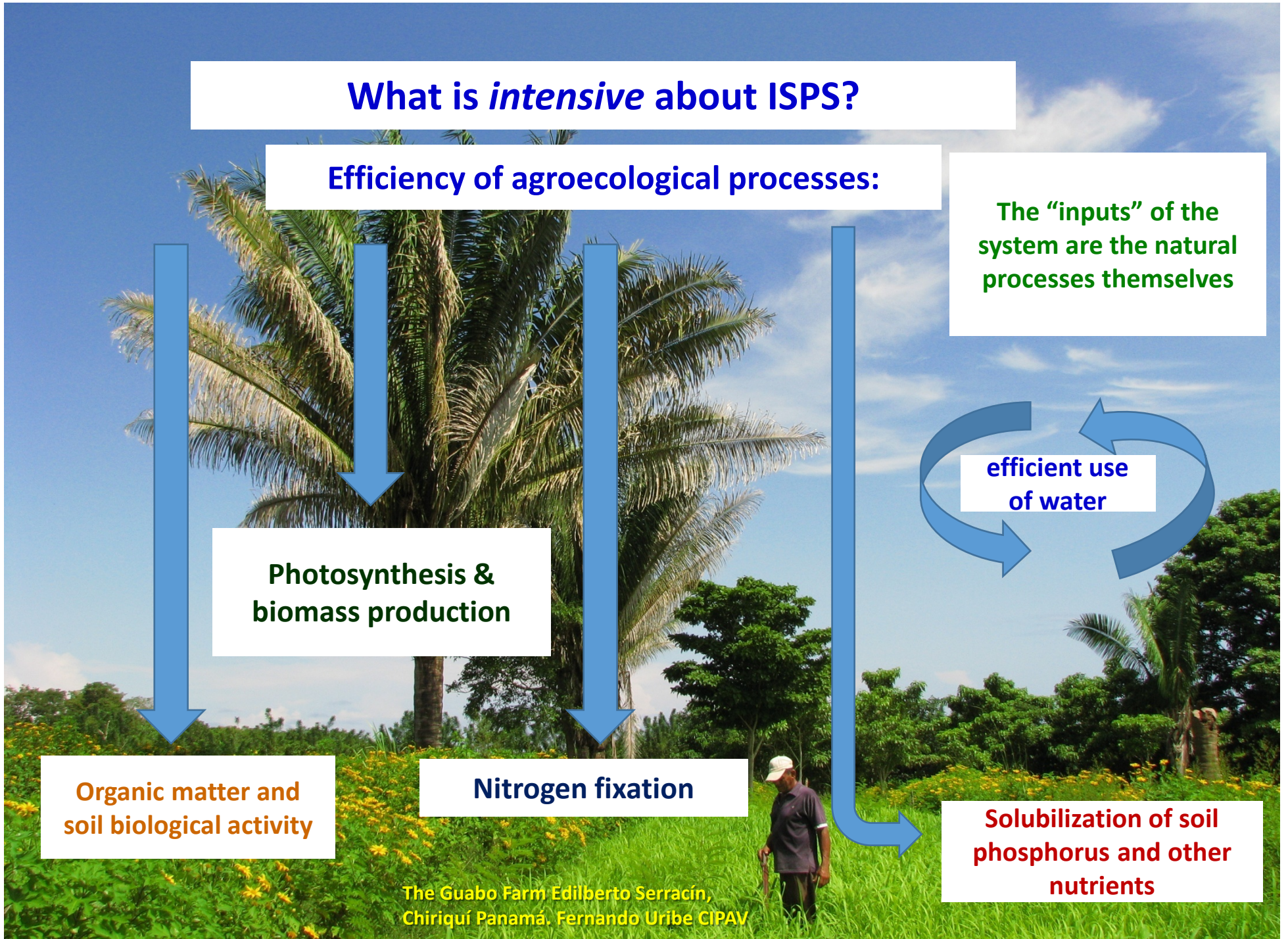
An agroforestry system that can be directly grazed by livestock. It combines:

Murgueitio et al., 2011

500 timber trees planted in east-west lines to minimize shading.

Fodder shrubs planted at high densities (>10,000 plants ha-1), intercropped with

Highly-productive pastures


What is *intensive* about ISPS?
Efficiency of agroecological processes:
The "inputs" of the system are the natural processes themselves
efficient use of water
Photosynthesis & biomass production
Organic matter and soil biological activity
Nitrogen fixation
Solubilization of soil phosphorus and other nutrients
The Guabo Farm Edilberto Serracín, Chiriquí Panamá. Fernando Uribe CIPAV

The key to successful ISS is the adequate selection of the species, *particularly the fodder shrub that is the backbone of the system.*

Two species have shown the best results:

Mexican sunflower *Tithonia diversifolia* Helm, Asteraceae

leucaena *Leucaena leucocephala* (Lam.) de Wit, Fabaceae

Two other species of fodder shrubs have shown promising results

Sauco *Sambucus nigra* L. (S. peruviana Kunth),
Family: Adoxaceae

Guacimo *Guazuma ulmifolia* L.,
Family: Malvaceae

Intensive Silvopastoral Systems iSPS

Pasture, timber trees, fruit trees or palms (25 to 200 mature trees per hectare) for direct grazing of livestock.

With permanent supply of mineralized salt and good quality water in mobile troughs.

Chandio *ejido*, Michoacan, Mexico. Red mexicana SSPi 2013

Intensive Silvopastoral Systems iSPS

Live fences are planted at the periphery and internal divisions of pastures.

Cattle are handled without violence with fixed or movable fences or electrical tape.

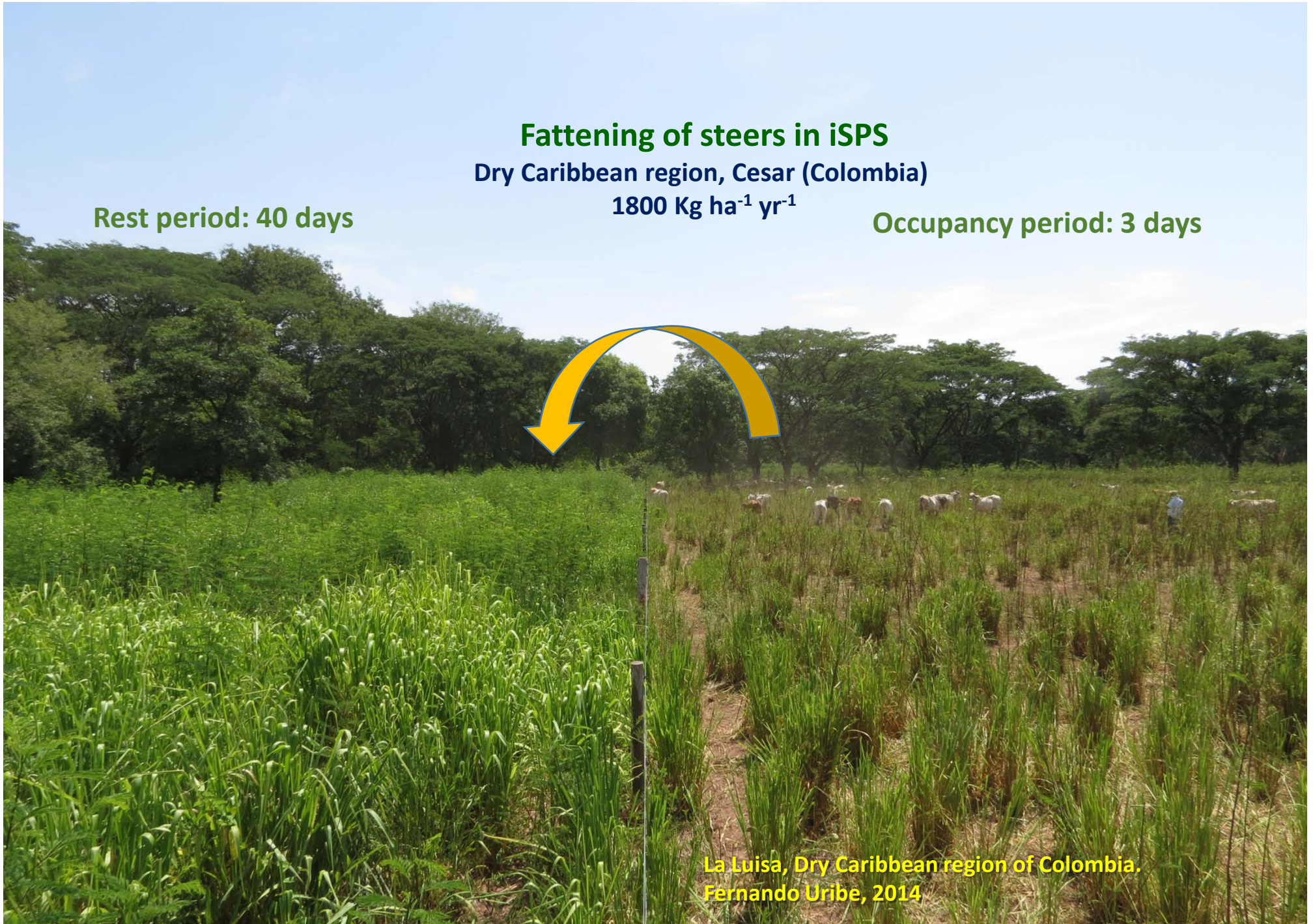
Fattening of steers in iSPS

Dry Caribbean region, Cesar (Colombia)

1800 Kg ha^{-1} yr^{-1}

Rest period: 40 days

Occupancy period: 3 days



La Luisa, Dry Caribbean region of Colombia.
Fernando Uribe, 2014

Water is always priority 1.

Otún river at La Pastora, Ucumarí – Risaralda.

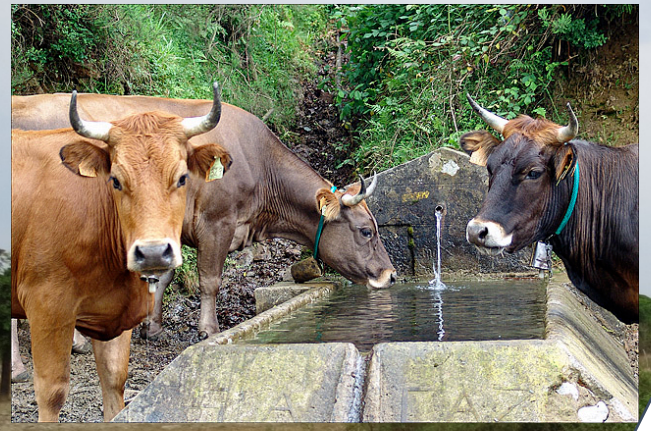
Photo: Daniel Uribe, 2009


Water goes to the livestock.
Animals never again fetch water.
Rincón de Luna farm (Estancia) , Corrientes (Argentina), October 2013

Water goes to the livestock; animals never again fetch water.

Otto Waidelich, Misiones, Argentina 2012

Where is the water for livestock?



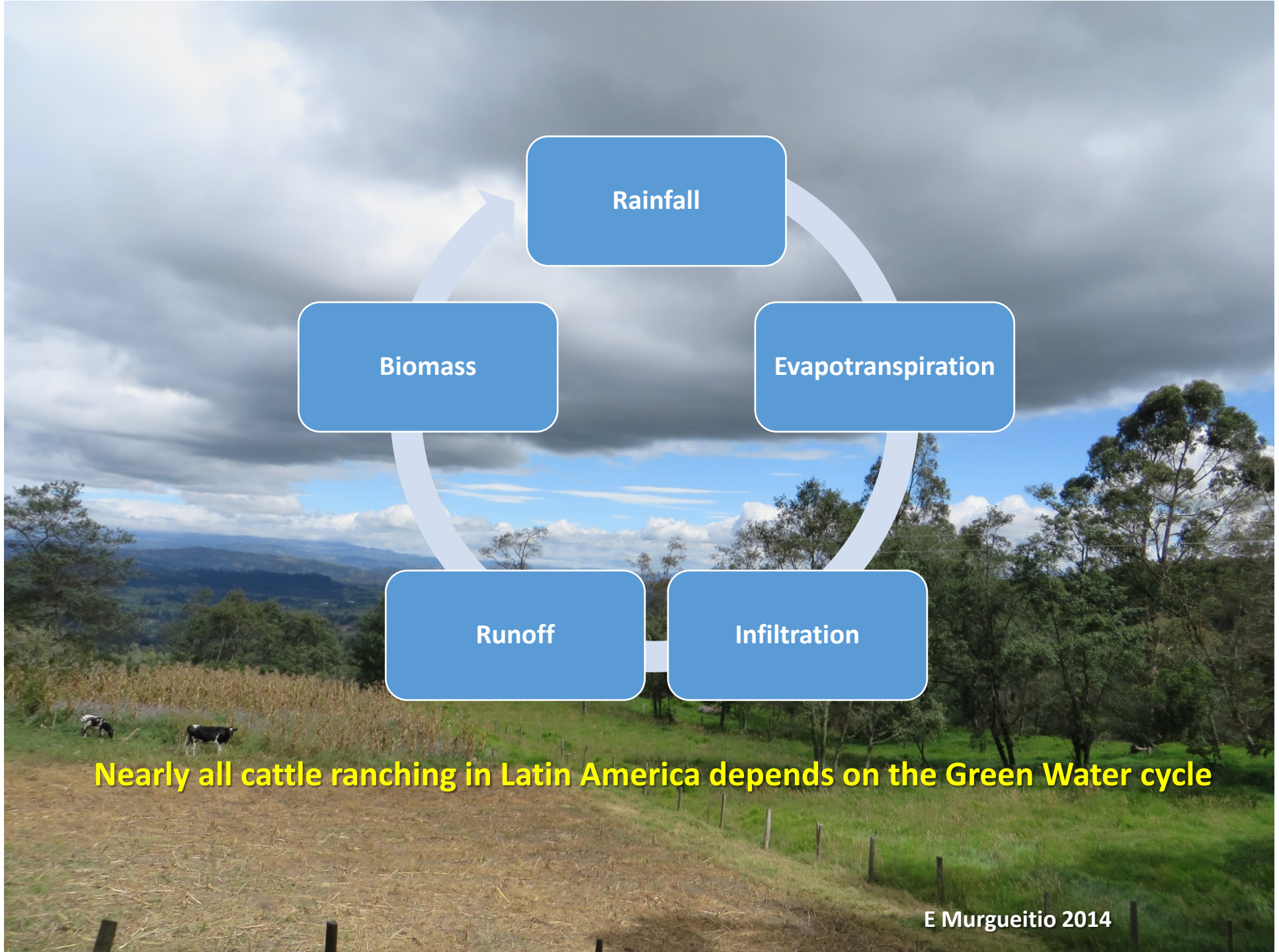
Gray water

Blue Water

Green Water

>90% in Latin American cattle ranching

Atlántico, dry Caribbean region (Colombia); March 2013


Rainfall
Evapotranspiration
Infiltration
Runoff
Biomass
Nearly all cattle ranching in Latin America depends on the Green Water cycle
E Murgueitio 2014

How can we improve the use of green water in rainfed livestock production?

1. Reducing water loss through runoff.
2. Harvesting and storing rainwater at all scales.
3. Improving infiltration of rain water into the soil.
4. Cutting down evaporation and evapotranspiration.
5. Accumulating water within soil organic matter.
6. Accumulating water in plant biomass.

Harvesting and storing water

Harvesting rainwater from ceilings to supply farm aqueducts

Asturias farm, Quindío
Colombia 2014

Rainwater harvest, Casanare farm, San Diego, Cesar
2014 Corpoica- CIPAV agreement.

Water harvest below a reforested hill. La Unión, Valle del Cauca (Colombia)
Surrounding vegetation reduces evaporation from the pond.
Enrique Murgueitio CIPAV 2010

Intensive Silvopastoral System - ISPS

The Six Green Water strategies together in a single rainfed livestock land use.

Rancho Las Tinajas. Michoacan, Mexico 2013.

Fernando Uribe, CIPAV

iSPS Productivity in the Caribbean region of Colombia

Productive parameters and stocking rates for different scenarios

	System			
	DP	IP	iSPS	iSPS + Timber
Plant productivity; t DM/ha/yr	7	19,2	28	28
Stocking rate AU/ha (1 AU=450 kg)	0.85	2.34	3	3
Yield; kg beef/ha/yr	77.6	341.6	711.8	711.8

Naranjo *et al.*, 2012

DP Degraded pasture
IP Improved pasture
iSPS Intensive Silvopastoral System
iSPS Intensive Silvopastoral System with timber trees

Clima y Sector Agropecuario Colombiano
Adaptación para la Sostenibilidad Productiva

MinAgricultura PROSPERIDAD PARA TODOS CIAT

iSPS in tropical Pacific region of Mexico

4 AU ha^{-1}; daily weight gain (800 a 1000 g $animal^{-1}$ day^{-1})

Solorio et al 2011, México

Intensive Silvopastoral Systems: key habitats for dung beetle conservation in livestock farms of the Cesar river valley (Colombia)

Giraldo, C., Montoya, S., Montoya, J., Chará, J. & Escobar., F. 2014

Evaluated land uses

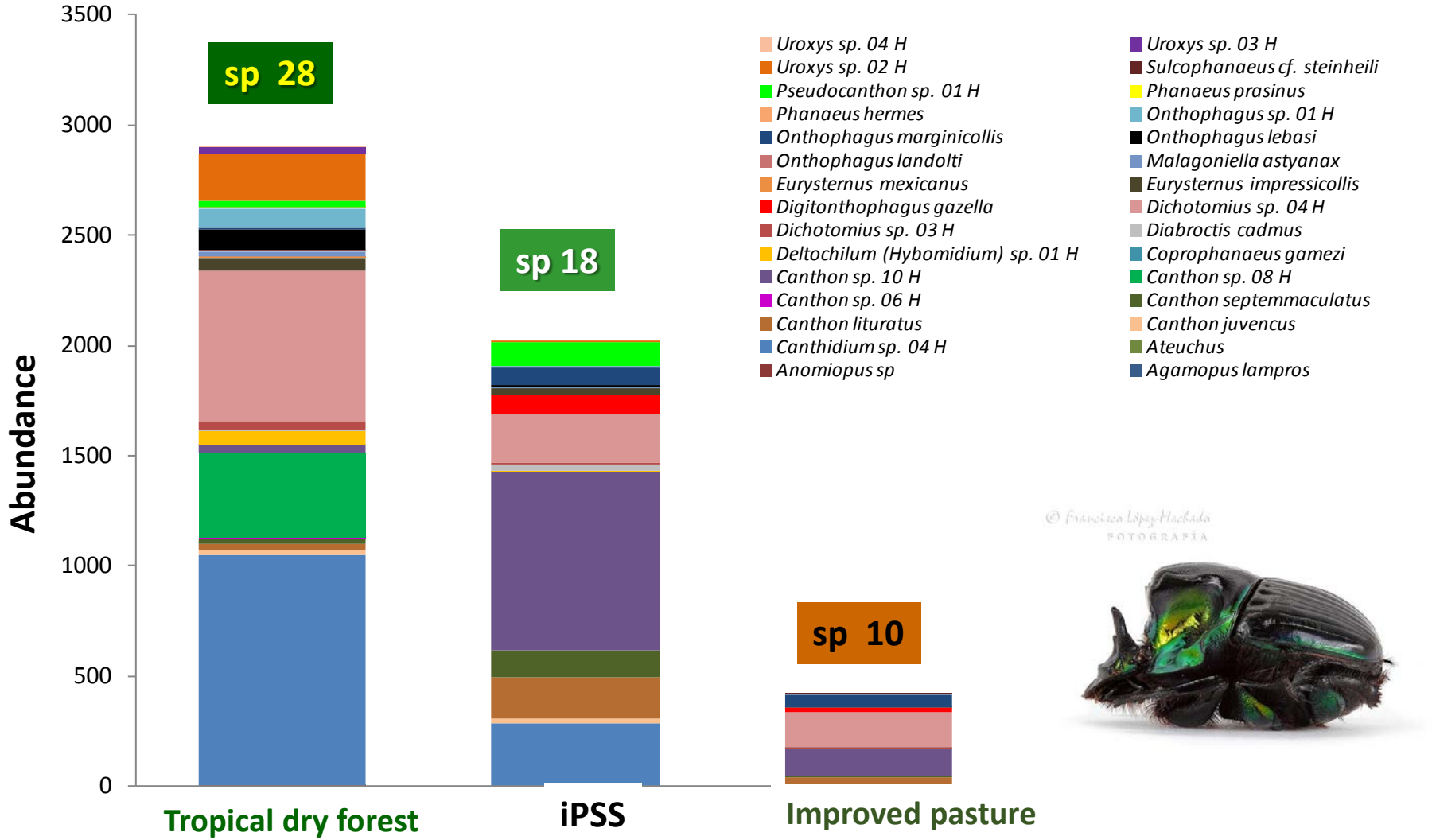
Tropical Dry Forest

iSPS

Improved pasture

Giraldo, C., Montoya, S., Montoya, J., Chará, J. & Escobar., F. 2014

Dung beetle abundance



Giraldo, C., Montoya, S., Montoya, J., Chará, J. & Escobar., F. 2014

Giraldo, C. 2014

		Tropical dry forest	iPSS	Improved pasture
Tunnel depht (average in cm)		16.5	23	8.4
Number of nesting balls Ha^{-1}		6.600	5.160	3.920
Soil removed (Kg Ha^{-1})		854.0	470.9	46.7
	 	~ 1 Ton Ha^{-1}	~ 0.5 Ton Ha^{-1}	~ 0.05 Ton Ha^{-1}

Different situations drive the convergence towards iSPS in Latin America

1. Lands degraded by grazing or rainfed agriculture.
2. Intensive livestock grazing systems relying on high inputs.
3. Timber plantations.
4. Fruit and nut tree plantations.
5. Regions affected by frost and unsustainable situations.

From lands degraded by grazing or rainfed agriculture to iSPS

Strategy

Increasing stocking rates and animal productivity and reducing the seasonality of production during the dry periods

Farming system

Breeding, dual-purpose (meat and milk), fattening, buffalo, sheep

Outcome

More milk and meat: 300 to 500% per hectare

Countries

Brazil, Colombia, Cuba, Mexico, Nicaragua, Panama, Paraguay, Venezuela

Maranhão, Brasil

Fazenda Monaliza

From intensive livestock grazing systems that depend on high inputs to iSPS

Strategy

Reducing the costs of fertilizers and commercial feeds.

Farming system

Dairy, dual-purpose (meat and milk) and fattening.

Outcome

Cheaper milk and meat 35 a 45% less L^{-1}

Countries

Colombia and Mexico

2006: **60 animals.** Milk production cost: **US $ 0,45 L^{-1}**
2012: **250 animals.** Milk production cost : **US $ 0,25 L^{-1}**

La Sofía and La Joya farms
Valle del Cauca, Colombia
Eduardo and Álvaro Llano, 2014

Tithonia diversifolia and stargrass ISPS for hair sheep
40 - 50 animals per hectare

Tinajas farm, Caldas (Colombia)

Pablo Uribe, CIPAV 2012

From timber plantations to iSPS

Strategy

Generating cash flow (short-term income) until the timber harvest and products with a higher market value than cellulose (larger diameter boles)

Production system

Breeding heifers; fattening

Outcome

Small and medium producers entering the forestry business.

Countries

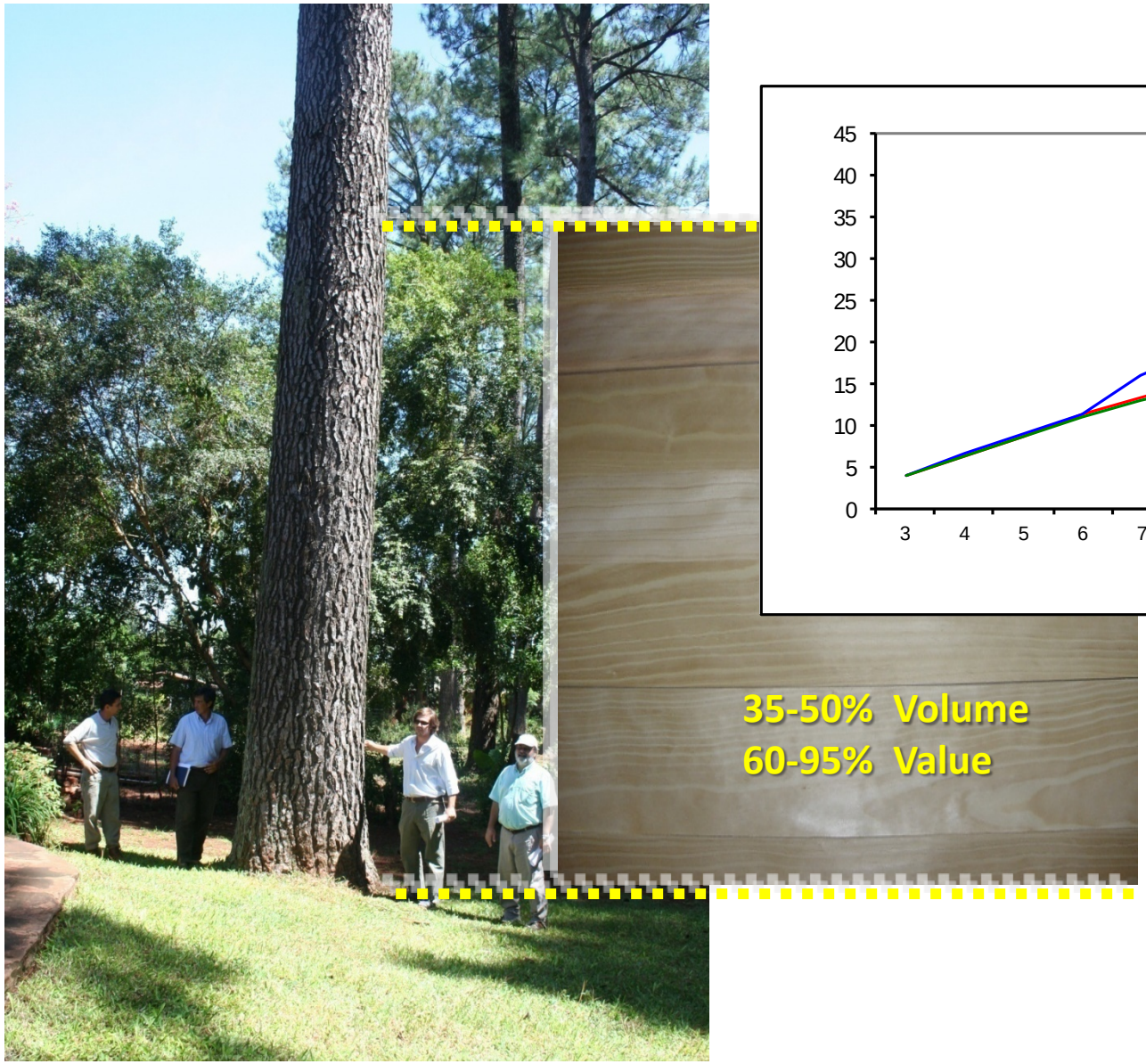
Argentina, Brazil, Colombia, Chile, Uruguay, Venezuela

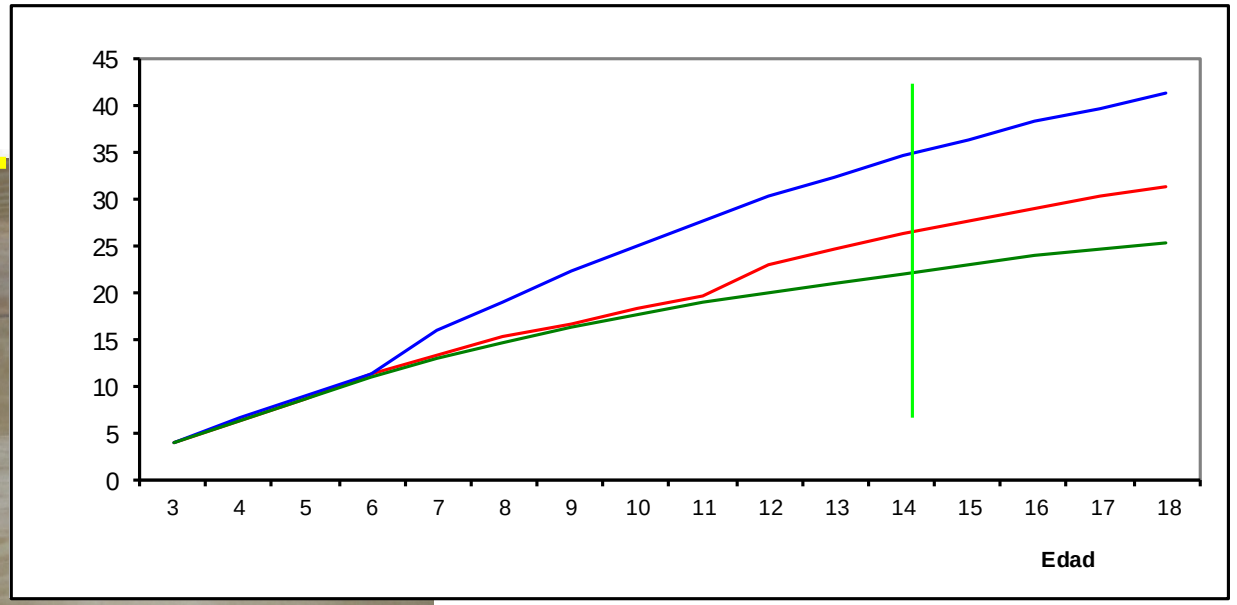
From pastures to timber plantations and then to ISPS

Northwestern Argentina (Misiones and Corrientes)

Esquivel and colleagues, 2013

Homogeneous plantation or SPS: change in diameter (cm)





SPS

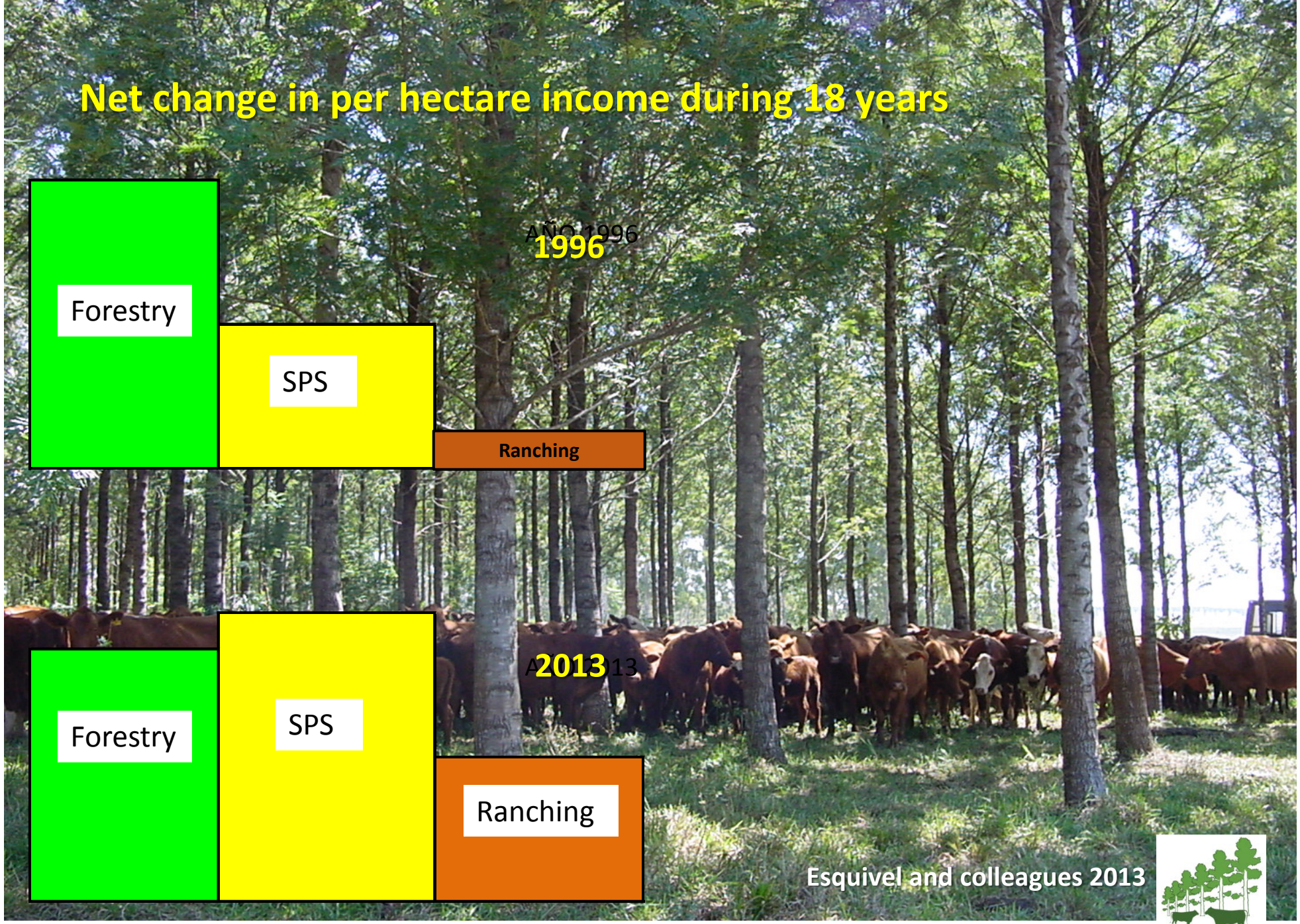
Forestry

No thinning

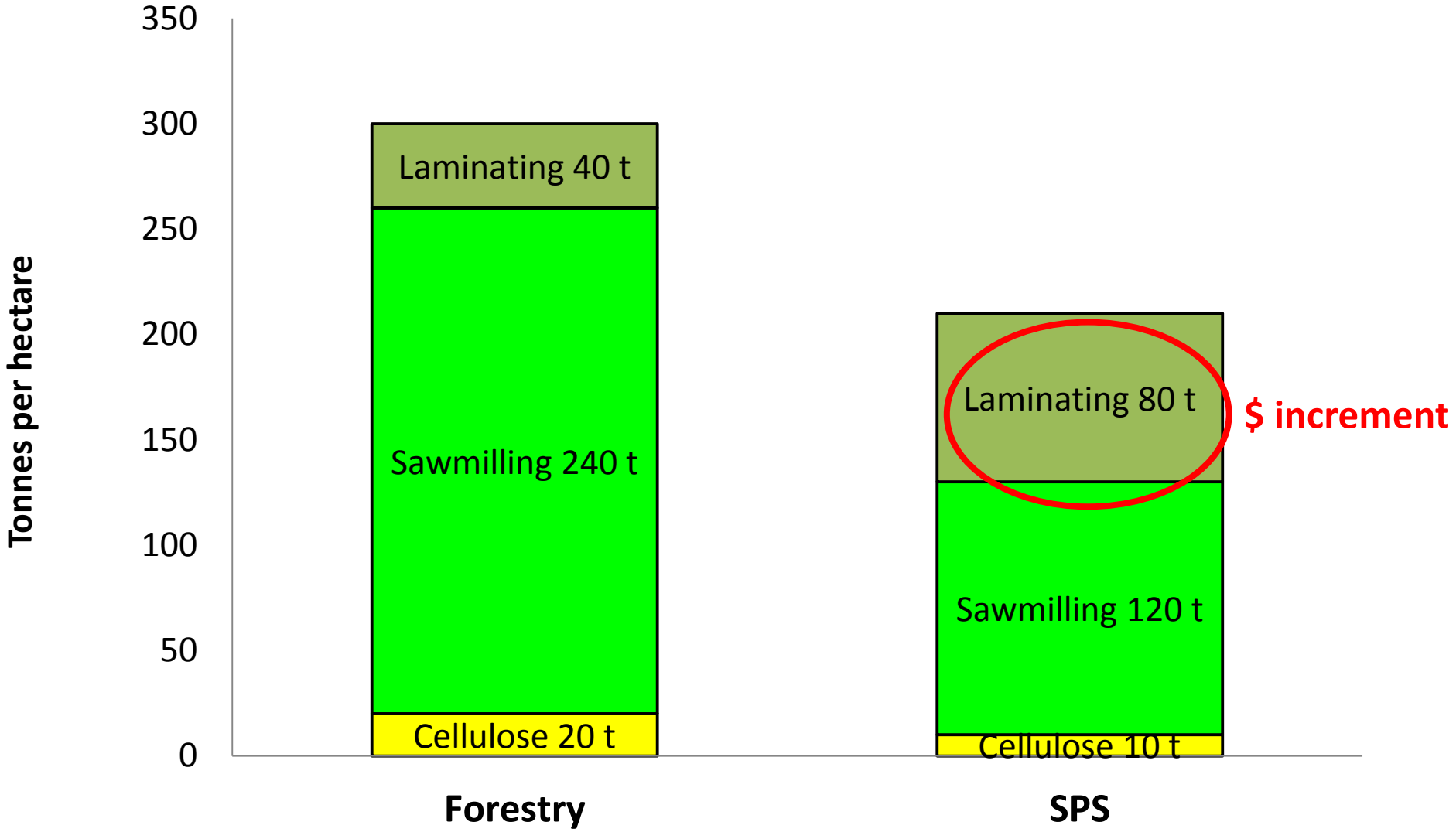
Age (years)

Lacorte and Esquivel 2011

Net change in per hectare income during 18 years



Conceptual scheme for the different products (tonnes ha^{-1})
Forestry vs Silvopastoral system (SPS) in Misiones and Corrientes (Argentina)



Esquivel and colleagues, CREA 2014

Financial indicators - fattening of cattle in the dry Caribbean region of Colombia

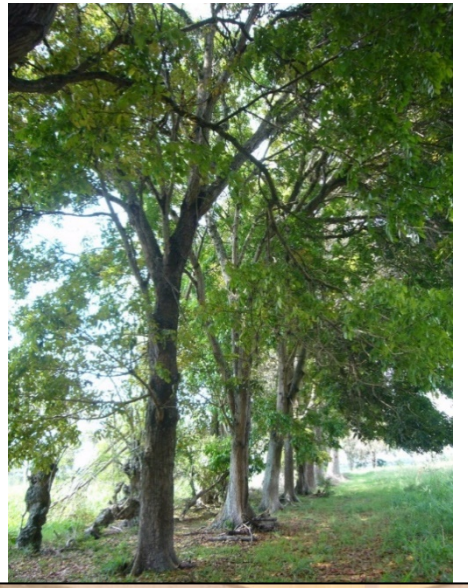
Pasture rotation without external fertilization and irrigation vs. SSPI with and without forest products
US $
Annual interest rate: 10%

System	Gross income $ha^{-1}\,yr^{-1}$	Profitableness $ha^{-1}\,yr^{-1}$	Internal rate of return
Pasture with no fertilization and irrigation	514	(-193.86)	Non-viable
iSPS with timber trees	3839	1623	37.0 %
iSPS without timber trees	2935	954	32.7 %

Murgueitio et al. 2014

The future of precious woods is in pastoral areas.

Mahogany *Swietenia macrophylla* King



From fruit and nut tree plantations to iSPS

Strategy

Using non-productive areas within the main crop and reducing costs (weed control, fertilizer)

Farming system

Breeding heifers, fattening, dual purpose, sheep

Outcome

20 – 30% cost reduction, enhanced cash flow during the first 4 years

Diversification of income

Countries

Brasil, Colombia, Mexico

Intensive silvopastoral system integrated into a lemon orchard. La Concha *ejido*, Apatzingan, Michoacan, Mexico.

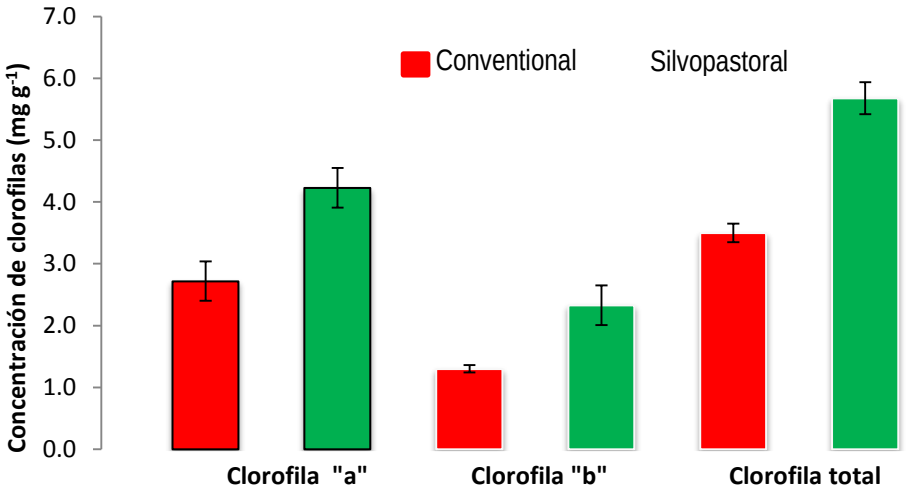
Ranferi Maldonado, U Chapingo – FPM 2013

Leucaena

Lower production cost:
Pest control (30%, decreases to 0%)
Weed control (30%, decreases to 0%)
Prunning (20%, increases to 30%)

"Shade lemon":

- **More abundant, larger, juicier and organic lemons.**
- **Access to a specialized market, with premium price.**



Lemon tree

Ranferi Maldonado, U Chapingo – FPM 2013
Calle and colleagues 2013

Caryodendron orinocense H. Karst. Euphorbiaceae

The Colombian nut:
inchi or cacay

iSPS in regions affected by frosts

Strategy

Urgent adaptation to climate change; cutting down the effects of frost and pests

Production system

Dairy, sheep, breeding heifers

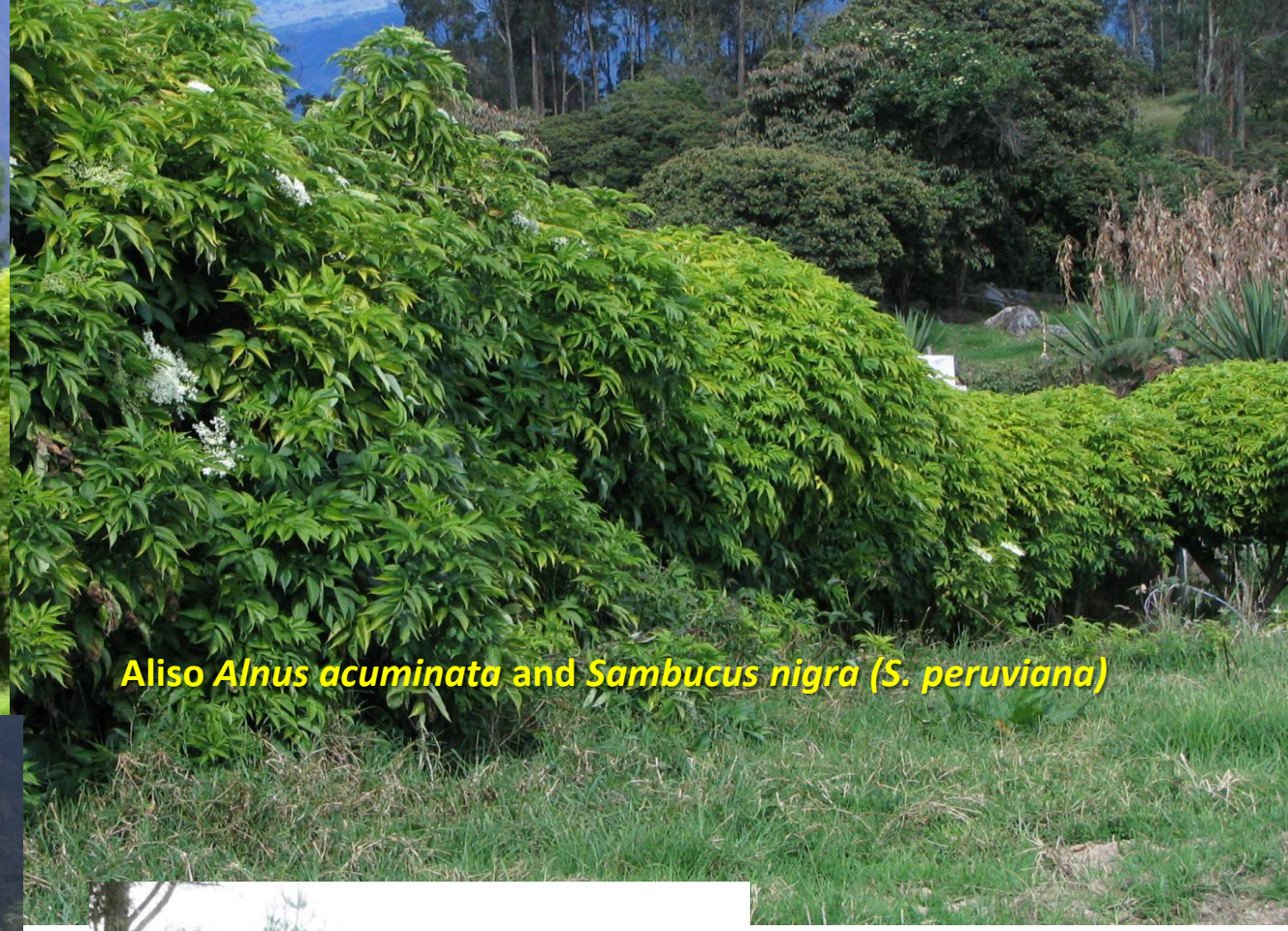
Outcome

80% reduction in frost damage to fodder; reduction of pesticide application on pasture (>10 yr^{-1} to zero)

Countries

Argentina, Brazil, Colombia, Uruguay

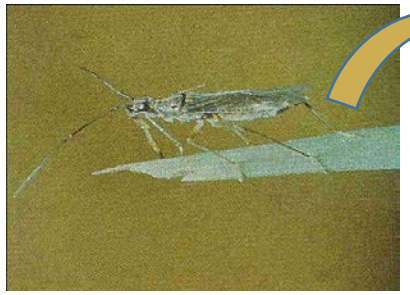
Sabana de Bogotá, Colombia.
Frost during 2009-2010 El Niño



Aliso *Alnus acuminata* and *Sambucus nigra (S. peruviana)*

Belén, Boyacá
Colombia.
Manuel Fajardo Fabegan 2012

Herbivory on *Pennisetum clandestinum* Hochst. ex Chiov. in Colombia



Collaria scenica Miridae

Hemiptera

Grass monoculture: 10 – 14 pesticide applications per year

ISPS: *Alnus acuminata + Tithonia diversifolia + Pennisetum clandestinum*

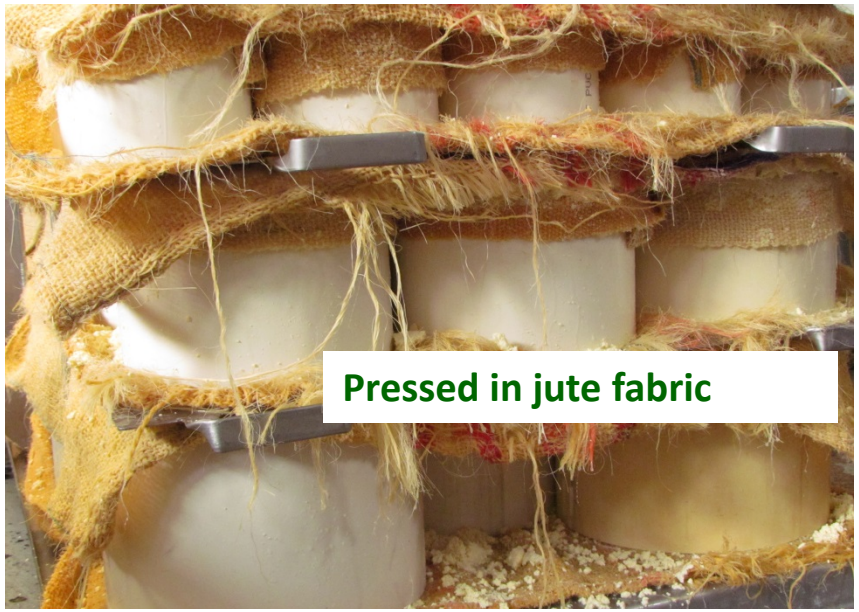
Zero pesticide applications

Lopera y col 2014

Tepeque cheese

(intensive silvopastoral Cotija type cheese)

Los Huarinches, Mexico



Pressed in jute fabric

National exhibitions of cheese EXPOQUESOS and milk products EXPOLACTEA 2013

Pleasant aroma, well developed. Pronounced flavor, deeply salty, distinctively yeasty. In the end, leucaena flavor!

Valle del Cauca, Colombia
***Labrantío* artisanal ,mature, Paipa type cheese. La Joya and La Sofía dairies.**
Eduardo and Tomás Llano 2014

Breaking the paradigm of meat quality in tropical grasslands: fattenning in iSPS

Gabriela Corral Flores PhD

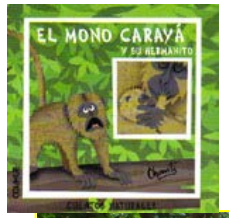
FUNDACIÓN PRODUCE MICHOACAN

iSPS meat quatiy. Dry tropics, Mexico

Intramuscular fat and fatty acid profile of beef steers fed in three feeding systems (P <0.05) (Longissimus dorsi between 12 and 13 intercostal space)

Test	Commercial feed	ISPS + rice flour	ISPS
IMF Intramuscular fat	5.47 ± 0.36^{a}	1.94 ± 039^{b}	1.79 ± 0.34^{b}
SFA Saturated fatty acids	56.92 ± 2.71^{a}	54.49 ± 2.12^{a}	50.59 ± 2.12^{a}
USFA Unsaturated Fatty Acids	33.80 ± 2.41^{b}	31.56 ± 1.89^{b,c}	40.46 ± 1.89^{a}
PUSFA Polyunsaturated fatty acids	9.28 ± 2.27^{b}	13.98 ± 1.77^{a}	8.95 ± 1.77^{b}
Ω - 6	8.82 ± 2.11^{b}	11.88 ± 1.65^{a}	6.35 ± 1.65^{c}
Ω - 3	ND	1.47 ± 0.84^{a}	1.08 ± 0.84^{a}

Corral et al 2014. In press



Carajá monkey *Alouatta caraya* eating leucaena in 12 year old trees.
***Rincón de Luna* farm (Estancia), Corrientes, Argentina**

E Murgueitio 2013

Forpus conspicillatus* eating seeds of *Tithonia diversifolia
Finca *La Cabaña,* Alcalá. Valle del Cauca. Colombia

Alirio Bolívar, August 20, 2014

iSPS support biodiversity

Planting trees gives us a sense of belonging to the land and a reason to stay
Luis Alfredo Quenza
El Paraíso farm, Arauca. Colombia


Planting trees gives us a sense of belonging to the land and a reason to stay
Diana Pizano
El Cubo farm, Sopó Colombia
Natalia Gómez
April 12, 2014