Options for sustainable cattle ranching in Latin America

Enrique Murgueitio R.

GLOBAL FORUM

"OPPORTUNITIES FOR GREEN BEEF PRODUCTION AND EXPORT IN COLOMBIA"

Valledupar, Colombia 17 June 2015

Livestock is deeply rooted among the rural population of Latin America and the Caribbean.

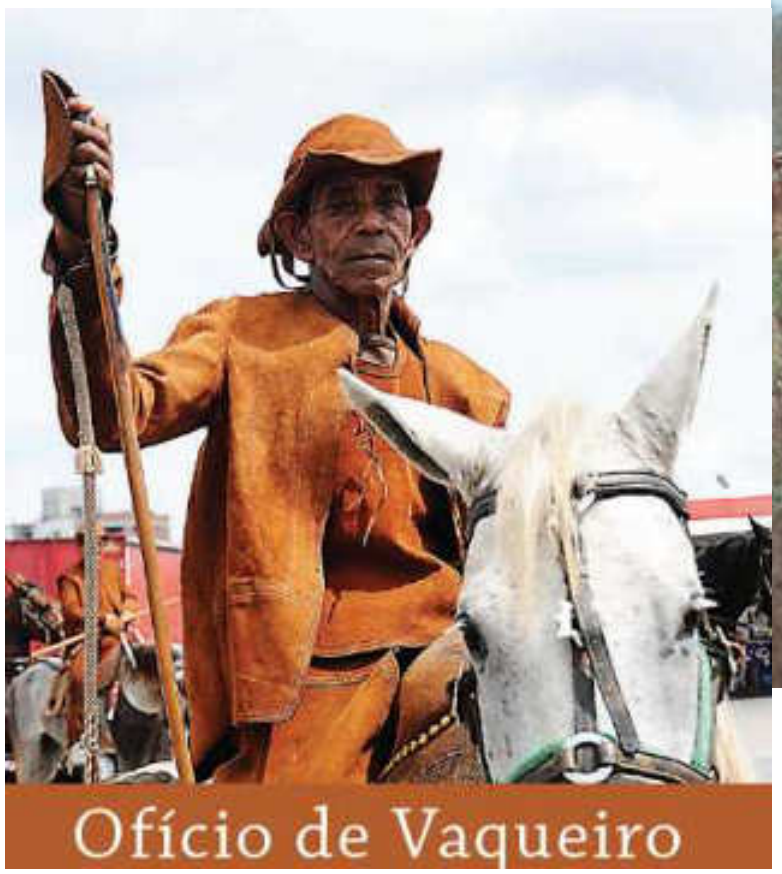
It is more than a business, it's a way of life and culture.

Estancia El Cebollatí, Uruguay

E Murgueitio 2014

Northeast Brazil

With over 400 years, the *cowboy work* in the Caatina biome (Sertao) is recognized as Cultural Patrimony of the State of Bahia, Brazil 2011



Eduardo Araujo

DECRETO Nº 13.159 DE 09 DE AGOSTO DE 2011

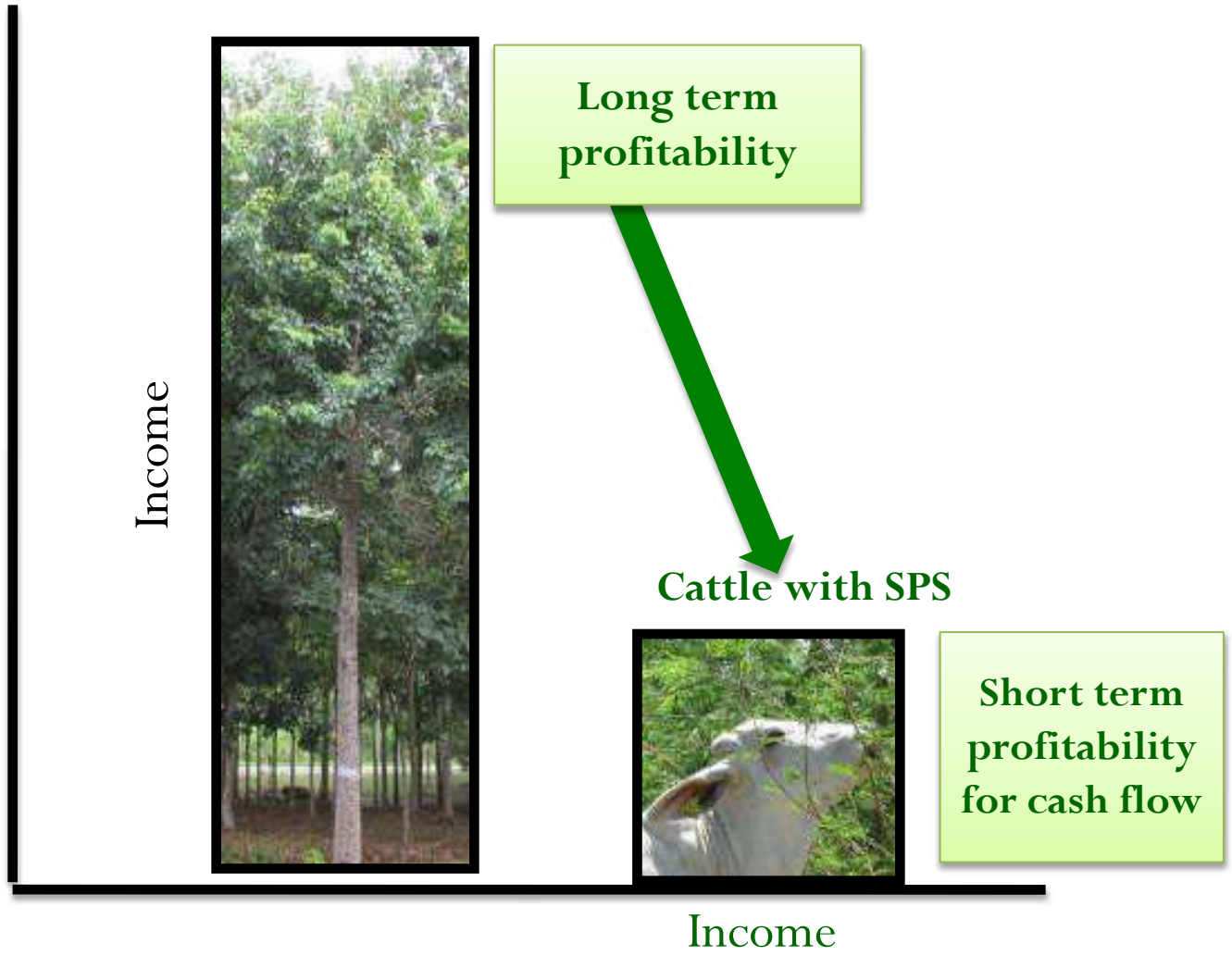
DECRETA

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

Cattle grazing and forestry: economic and social synergy



Lacorte y Esquivel 2009

Chaco Region

Mixed forests with algarrobo and quebracho 6.5 million ha with livestock(Peri 2015)

SPS in a forest with *Nothofagus antarctica* in Patagonia as wind barrier and firewood production. Cattle and sheep.
526,100 ha. Peri P. 2015

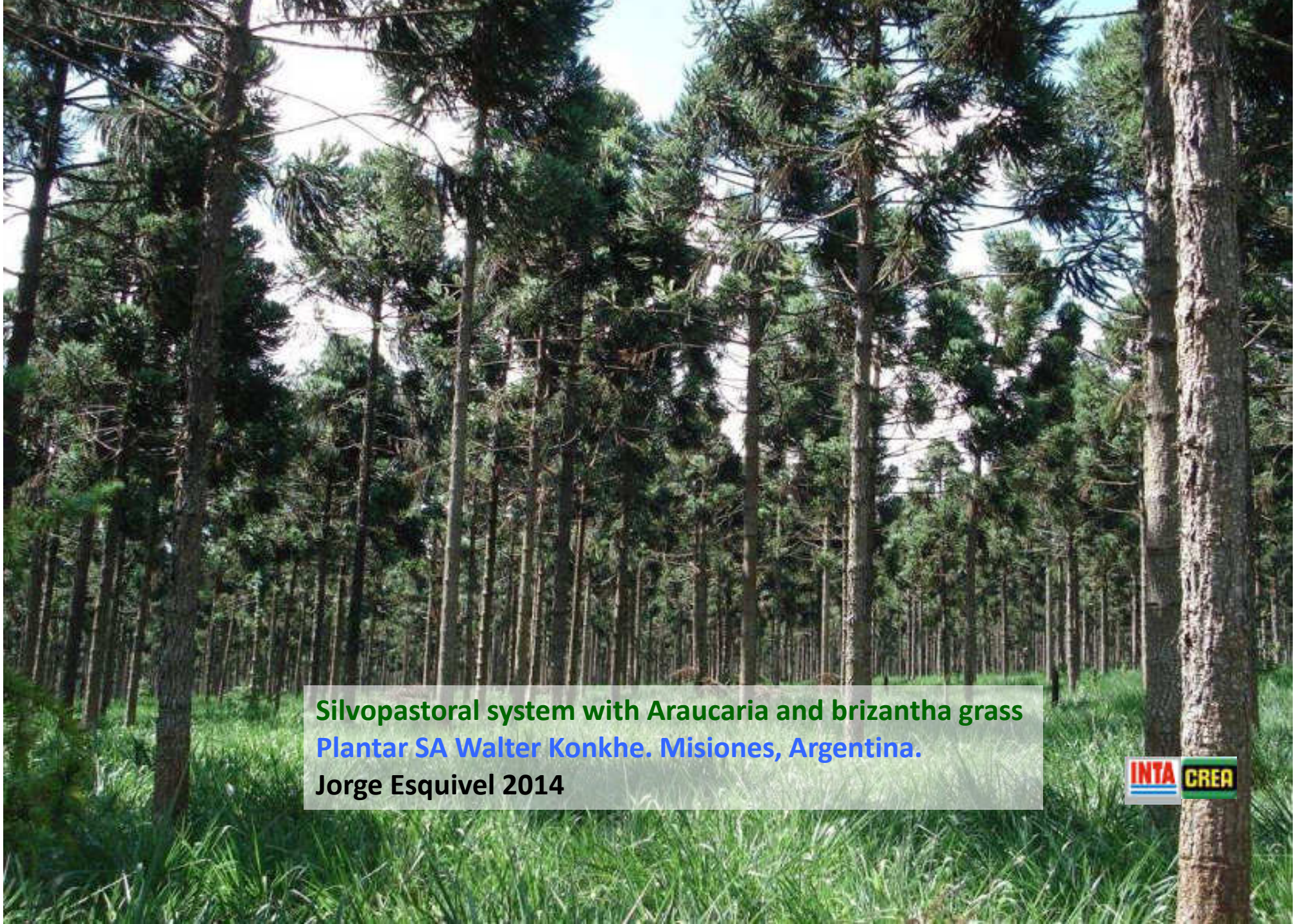
SPS in temperate region with 5 years old *Salix* (5x5 m), Aberdeen Angus heifers and *Carex riparia*. Peri P. 2015

Delta of Parana, Argentina

Parana Delta. SPS in temperate zone with poplar *Populus deltoides*' Stoneville 67 "(6x6 m), *Bromus catharticus* grass and ryegrass *Lolium multiflorum*. Peri P. 2015

Silvopastoral system with pine and Jesuita grass.
Plantar SA Walter Konkhe. Misiones, Argentina

Silvopastoral system with *Grevillea robusta* and brizanta grass.
Misiones, Argentina. 2014. Jorge Esquivel



Silvopastoral system with Araucaria and brizantha grass

Plantar SA Walter Konkhe. Misiones, Argentina.

Jorge Esquivel 2014

SPS in Uruguay

Silvopastoril livestock

Silvopastoril forest

Integrated for pulp

Integrated for timber

Roberto Scoz
INIA Uruguay, 2015

Agroforestry systems, Chile

Sotomayor A. 2015

Brazilian cattle population (IBGE,2003)

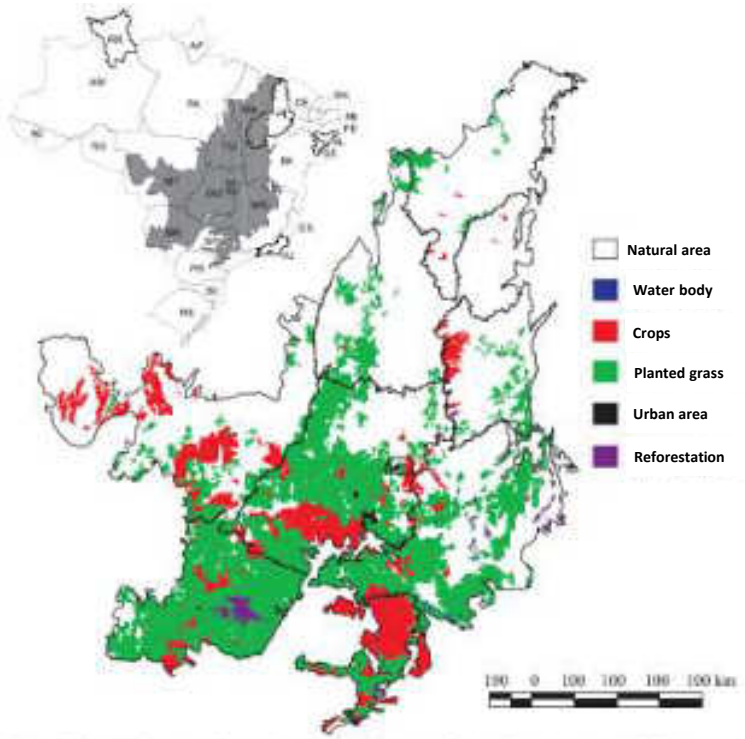
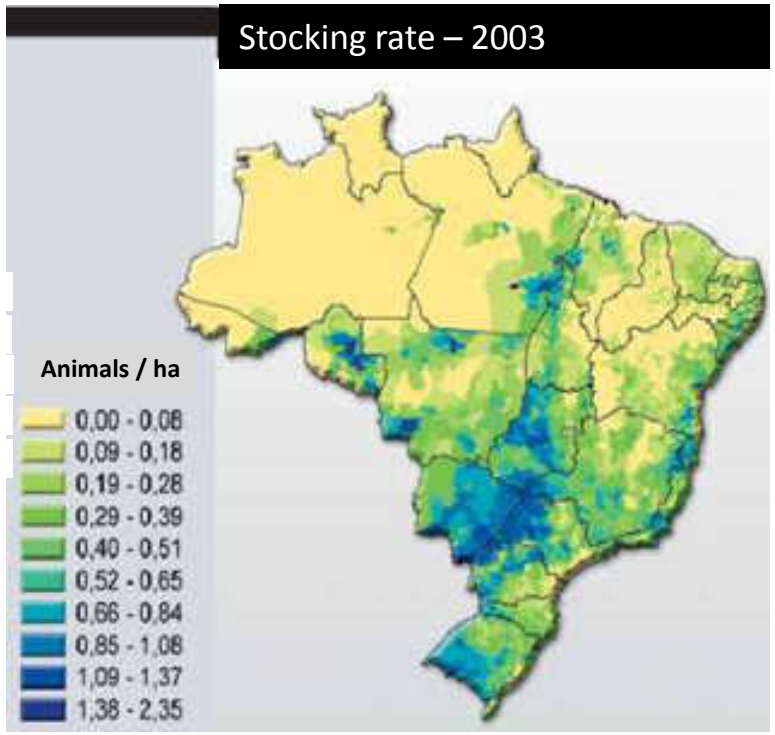


Figura 1. Distribuição espacial das classes de uso da terra no Bioma Cerrado no ano de 2002.



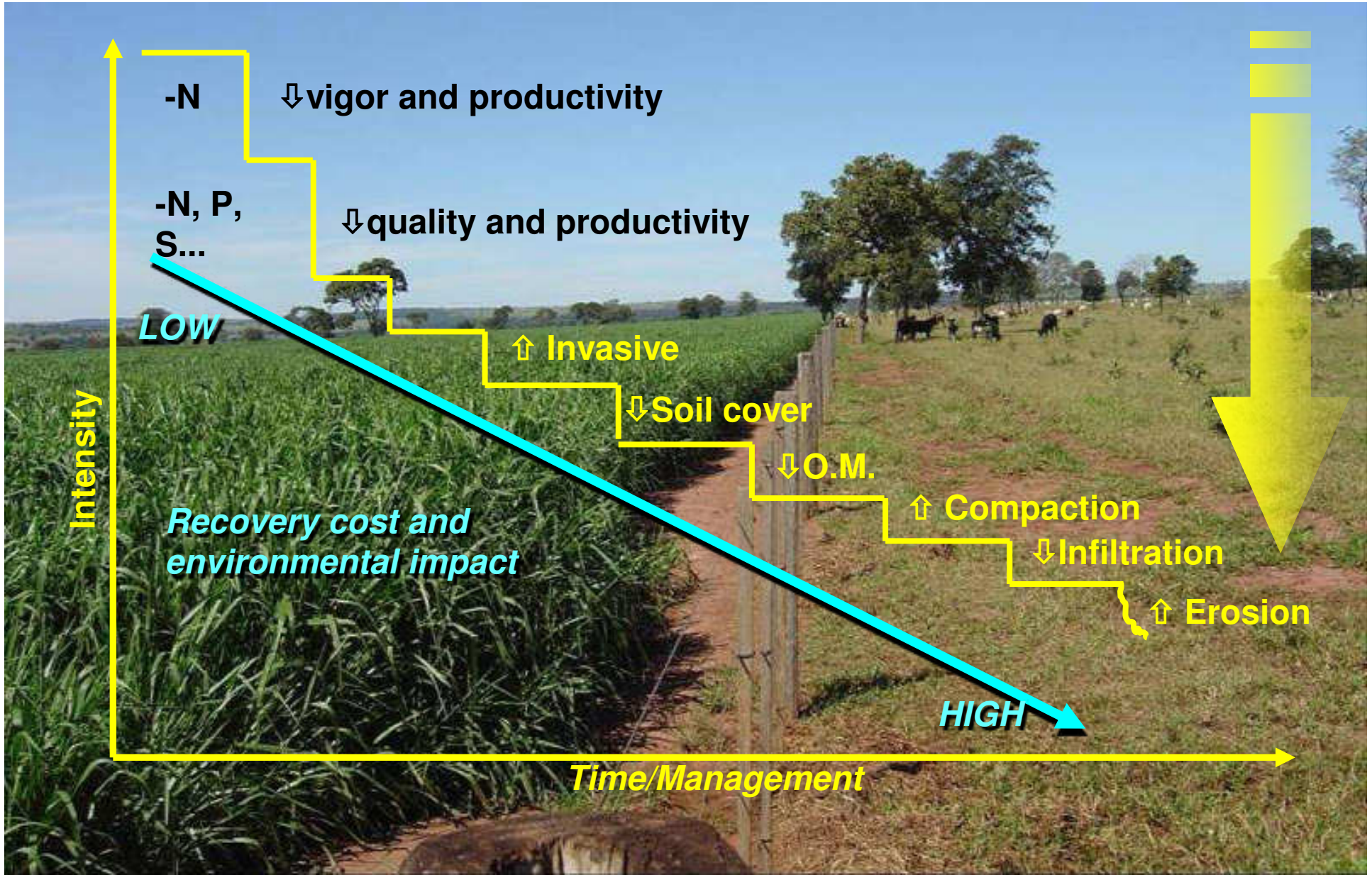
Source: Sano et al. (2008)

Today there are 200 million ha of pasture without trees.
Da Silva 2015

Embrapa

Embrapa
Gado de Corte

PRODUCTIVITY LOSS AND PASTURES DEGRADATION



Agricultural, livestock and forestry integration (iLPF)

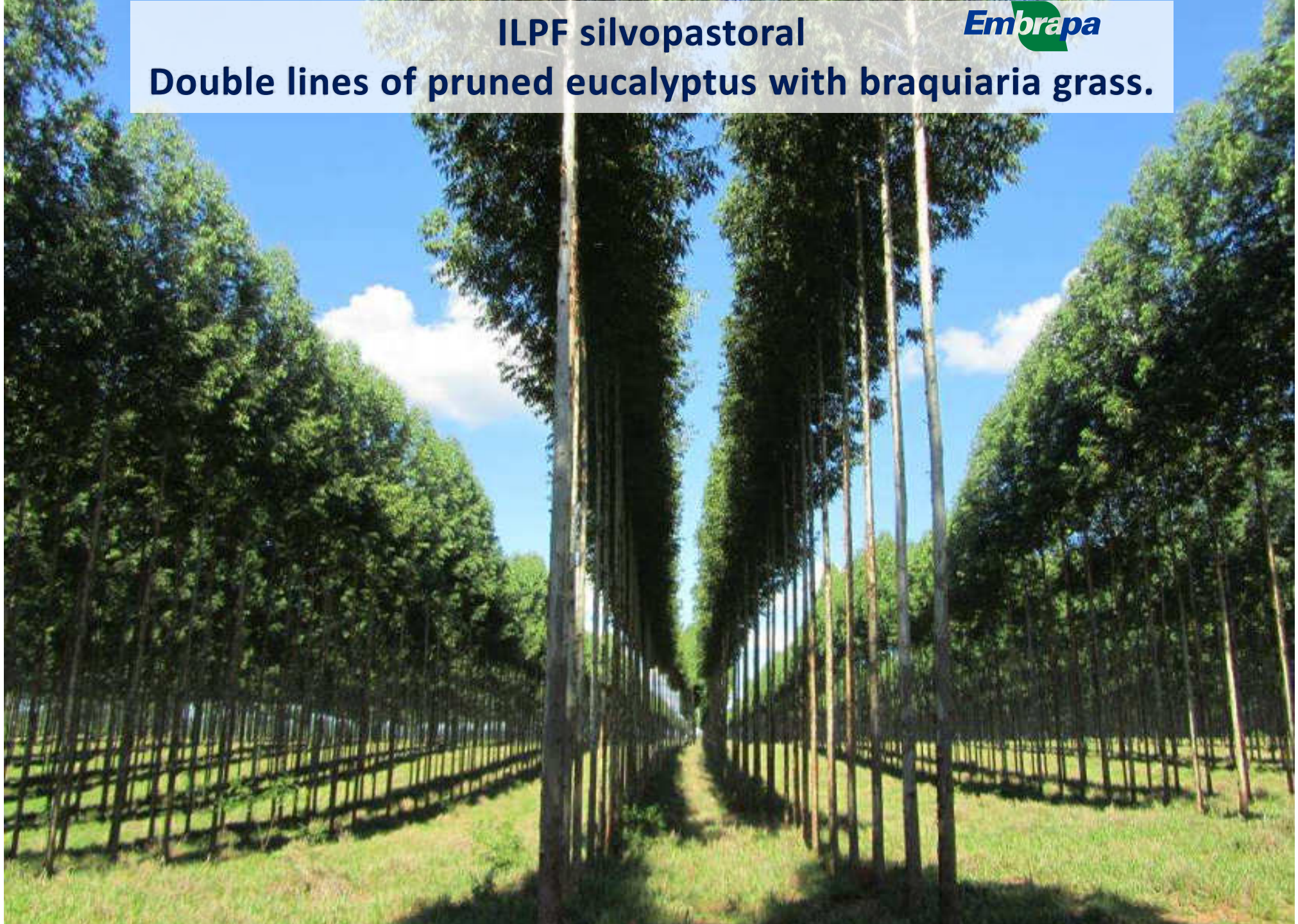
It is a strategy of sustainable production that integrates agricultural, livestock and forestry activities in the same area.

iLPF
Integração Lavoura-Pecuária-Floresta

Embrapa
Cerrados

ILPF silvopastoral

Double lines of pruned eucalyptus with braquiaria grass.

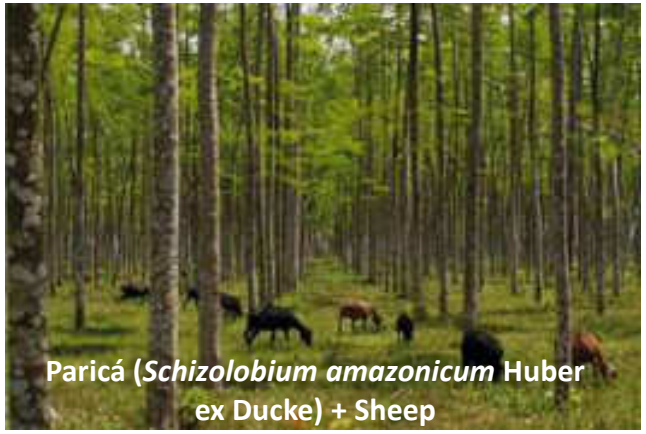



Eucalyptus + grevílea + oats e rye grass + livestock


Eucalyptus + braquiaria + livestock


Eucalyptus + Cynodon + livestock


Eucalyptus spp. + Soy


Paricá (*Schizolobium amazonicum* Huber ex Ducke) + Sheep


Diversas arbóreas nativas + livestock


Samaúma (*Ceiba pentandra* Gaerth) + livestock

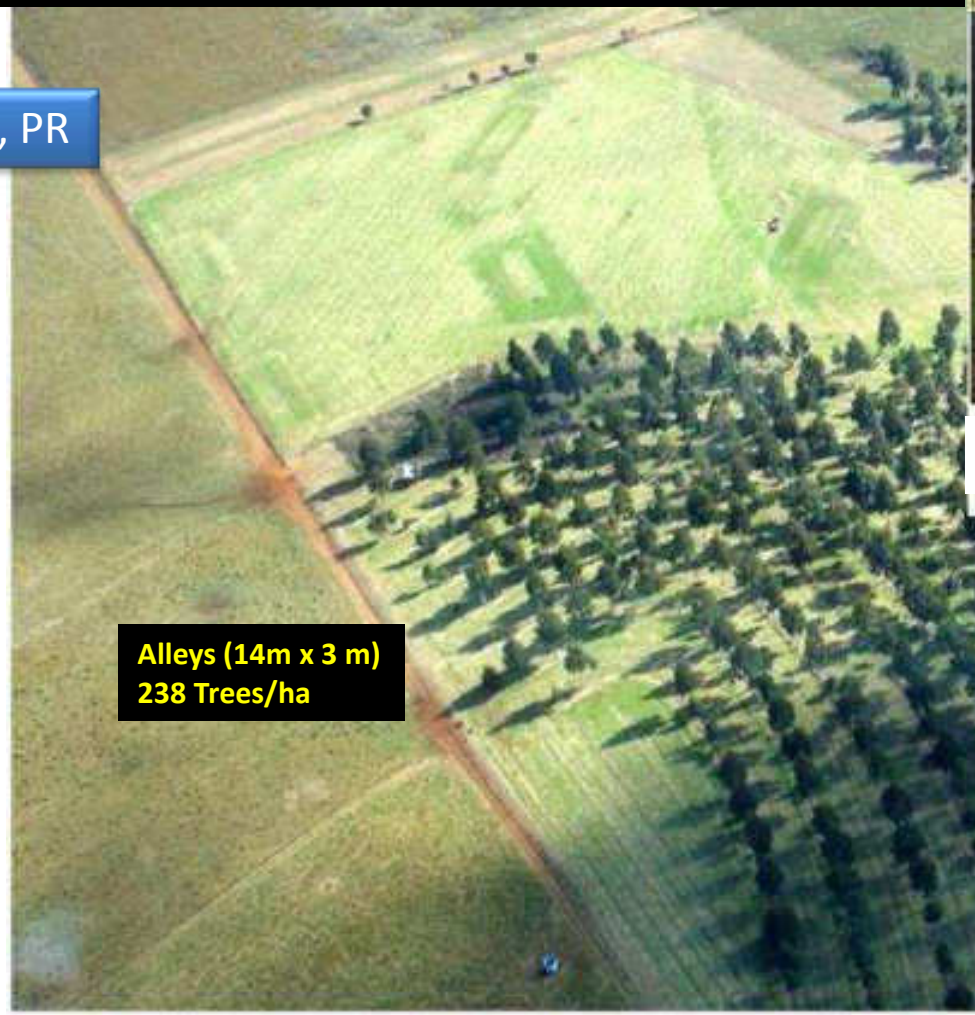

Ochroma pyramidale + Rice


Tectona grandis + Soy

Da Silva 2015

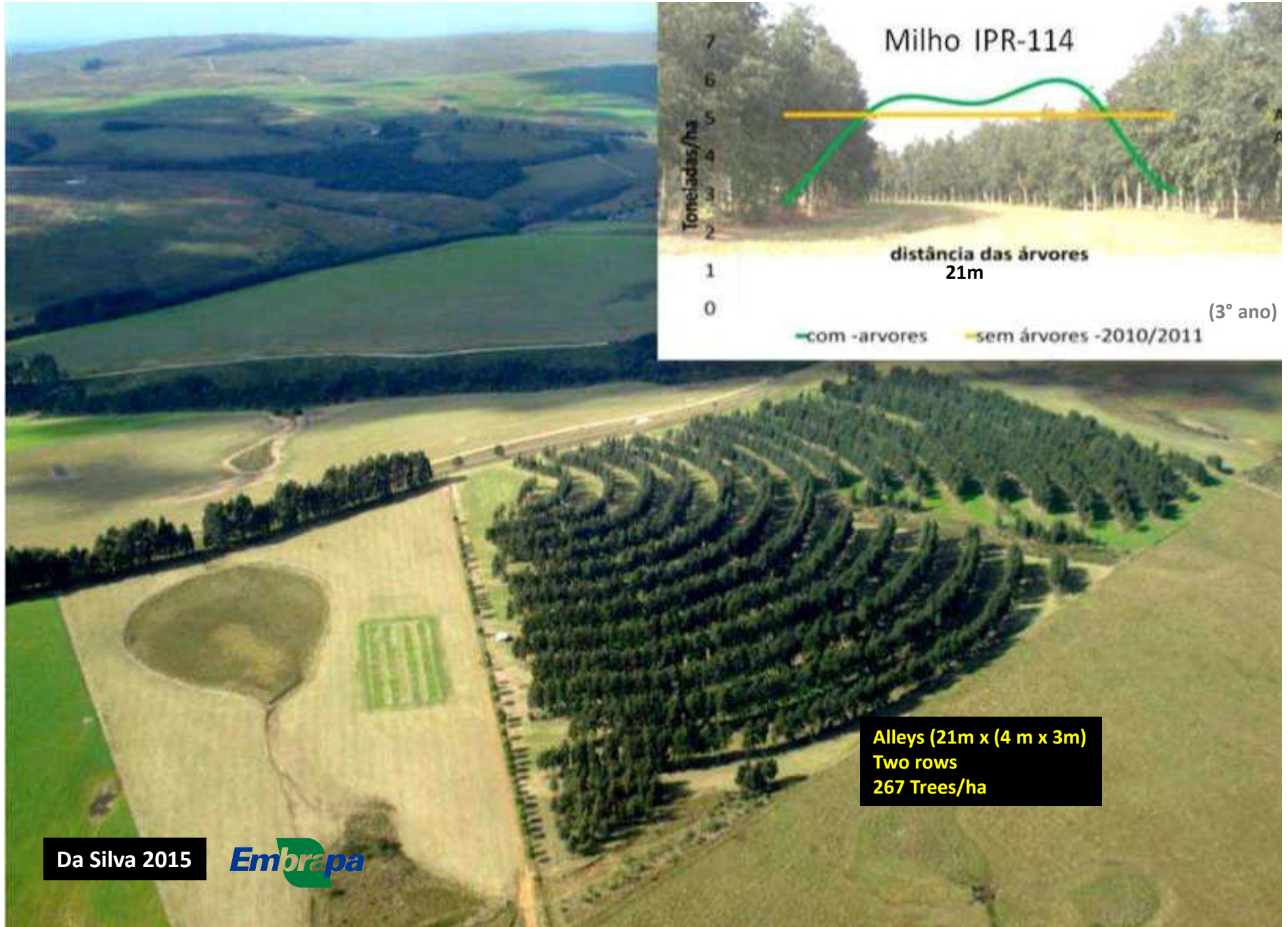
Technological Reference Units (RUT) crop-livestock-forest integration

Ponta Grossa, PR



Per agricultural year: > 10.3 m^3 of timber per ha

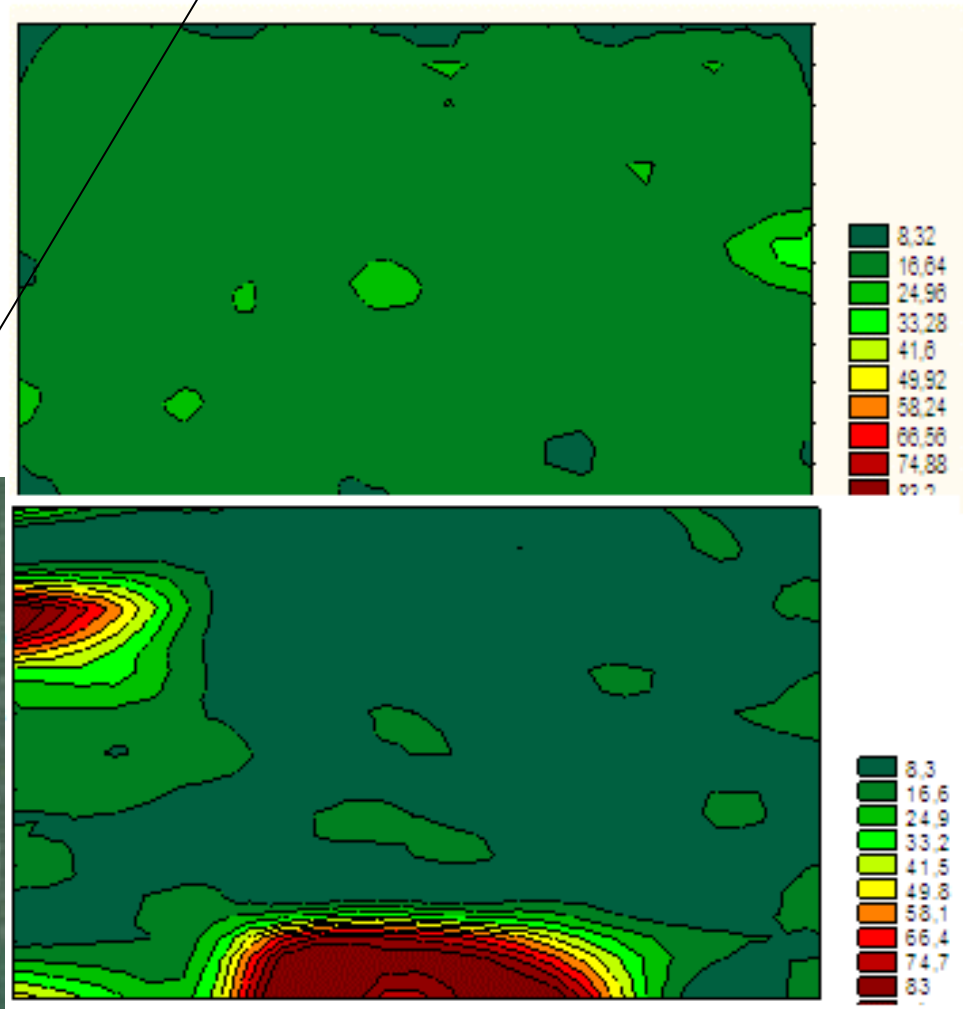

E Murgueitio 2013


Milho IPR-114
Toneladas/ha
7
6
5
4
3
2
1
0
distância das árvores
21m
(3° ano)
com -arvores
sem árvores -2010/2011
Alleys (21m x (4 m x 3m)
Two rows
267 Trees/ha
Da Silva 2015
Embrapa

Livestock manure distribution in the silvopastoral system.

90% of the nutrients ingested by cattle return through feces and urine (Monteiro & Werner, 1997)

Silvopastoral System



Pastures without trees

Porfírio-da-Silva 2015 Adaptado de Kruschewsky, 2009

Intensive silvopastoral system ISPS

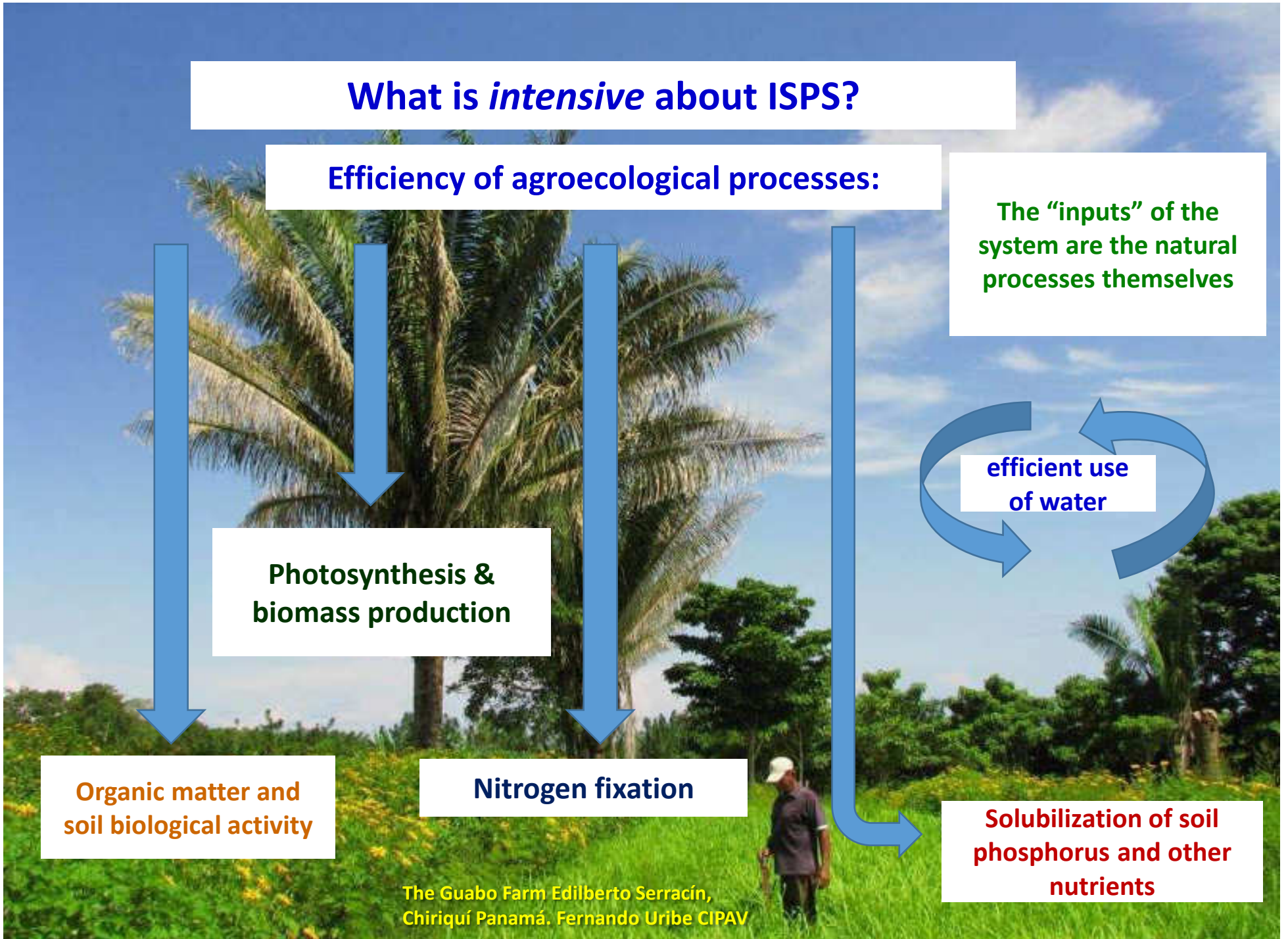
An agroforestry system that can be directly grazed by livestock. It combines:

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
Photosynthesis & biomass production
efficient use of water
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

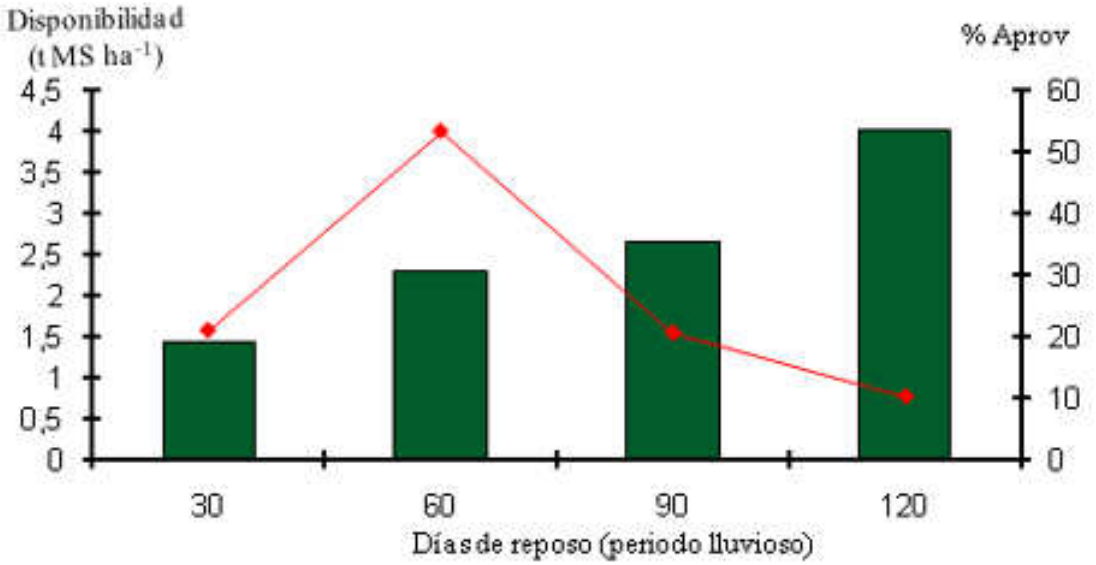
The key to successful ISS is the adequate selection of the species, *particularly the fodder shrub that is the backbone of the system.*

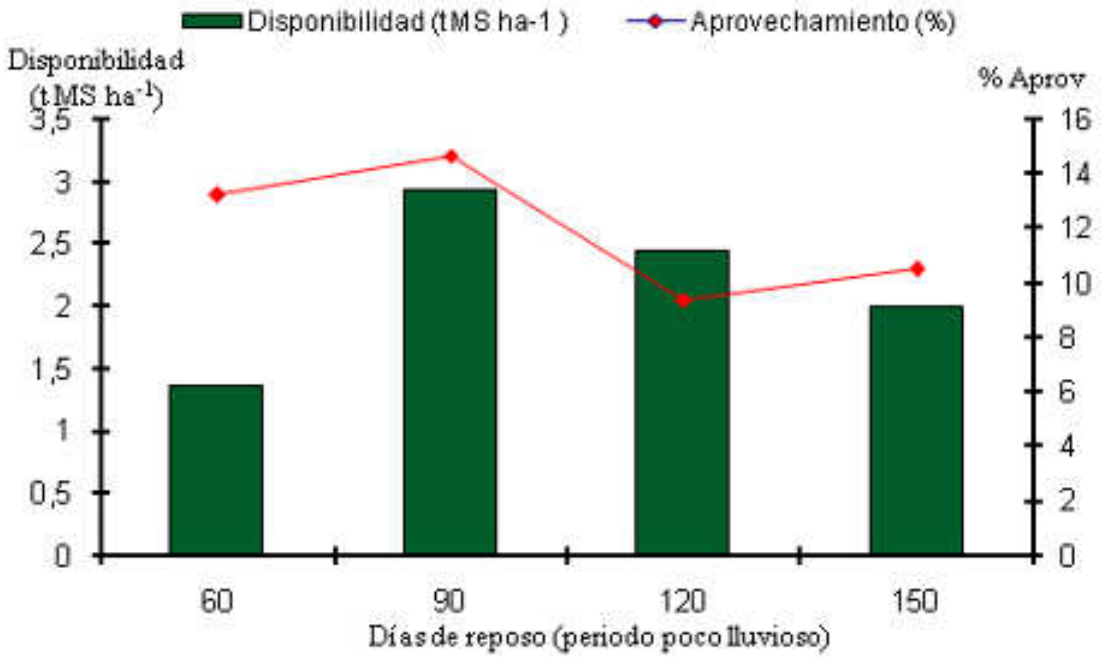
Two species have shown the best results:

Mexican sunflower *Tithonia diversifolia* Helm, Asteraceae

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

Tithonia diversifolia productive performance of grazing with different resting periods in both seasons. ICA - Cuba





It is possible to manage the *Tithonia diversifolia* in silvopastoral systems with 60 and 90 days of rest in the rainy season and dry seasons, respectively.

Alonso Lazo J, Achang Fraga G, Tuffi Santos L D y Arruda Sampaio R 2015: Comportamiento productivo de *Tithonia diversifolia* en pastoreo con reposos diferentes en ambas épocas del año. *Livestock Research for Rural Development. Volume 27, Article #115.* Retrieved June 3, 2015, from http://www.lrrd.org/lrrd27/6/alon27115.html

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.

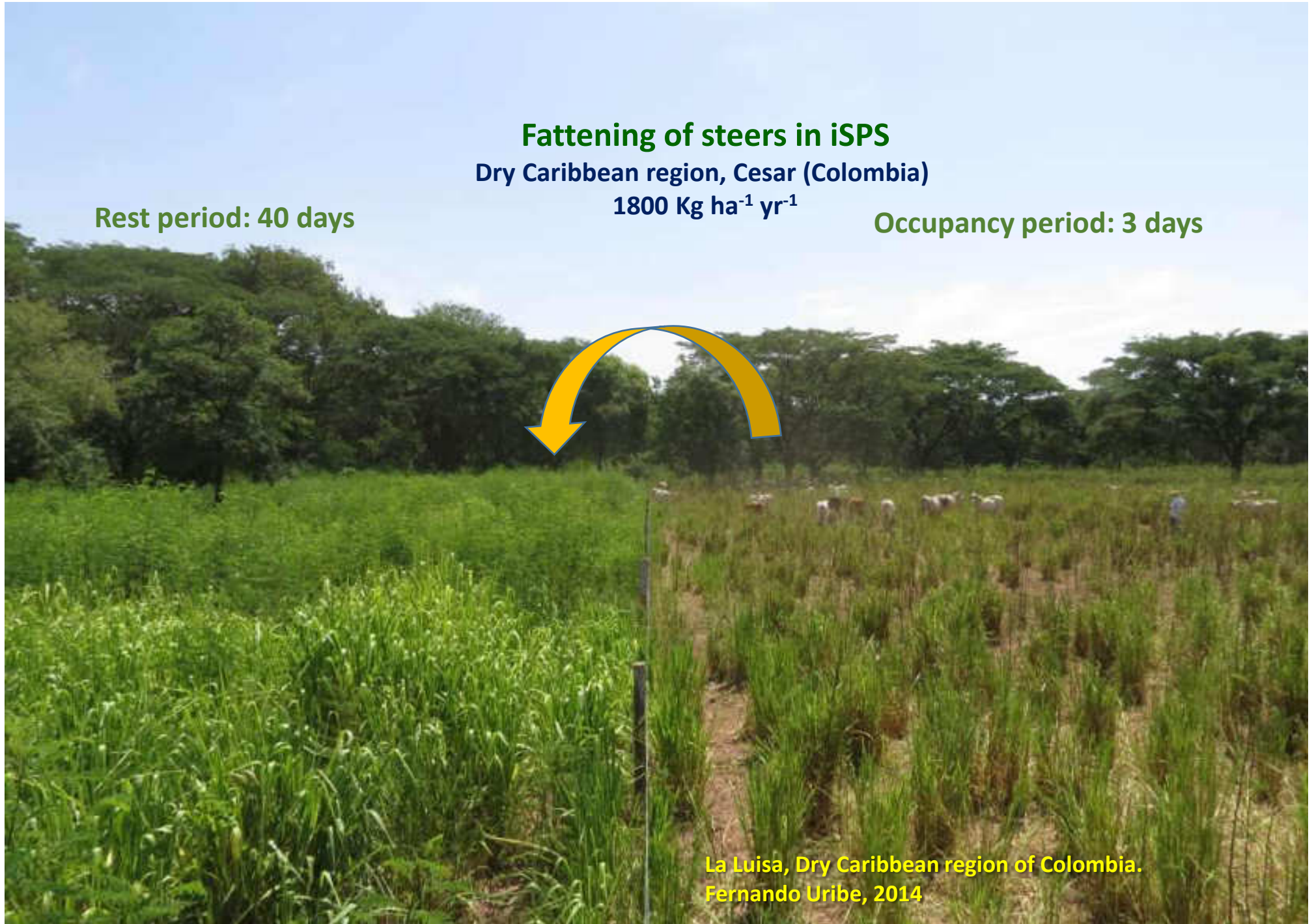
With permanent supply of mineralized salt and good quality water in mobile troughs.

Chandio *ejido*, Michoacan, Mexico. Mexican network of iSPS 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

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 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

Animal Welfare

Describe how individuals cope with the environment, including health and feelings as well as other positive and negative effects on the mechanisms that are activated to face this environment (OIE).

The welfare of an individual is its integral state in relation to their attempts to adapt to the environment

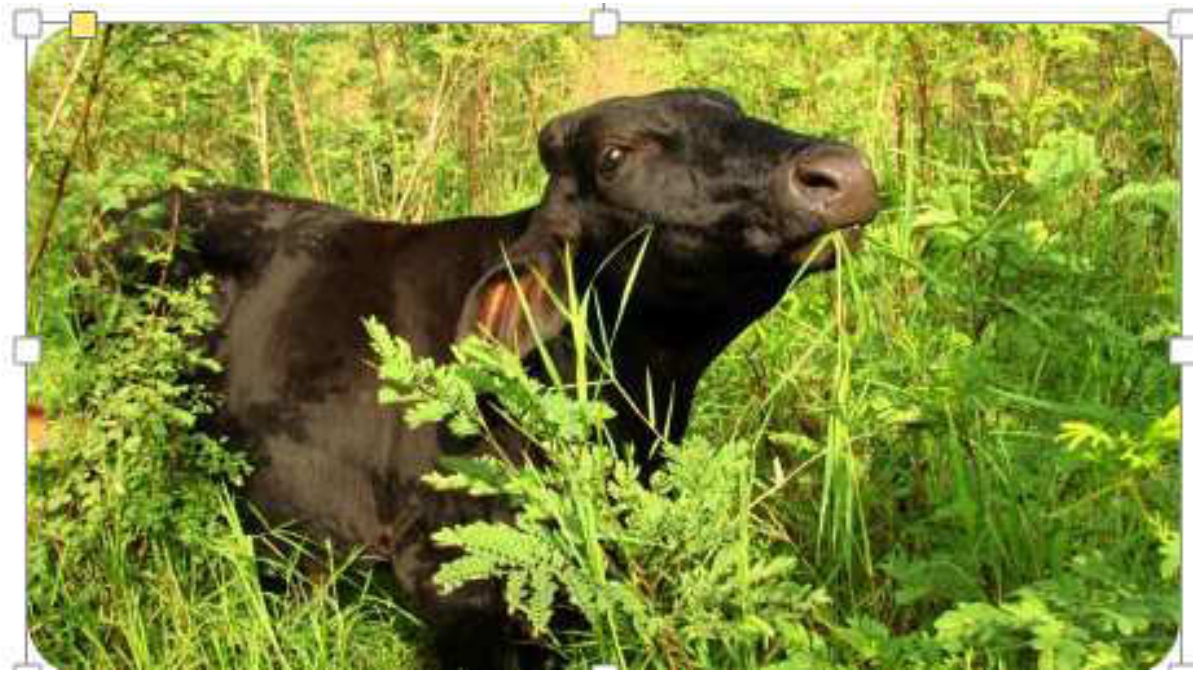
Donald Broom
Centre for Animal Welfare and Anthrozoology
Department of Veterinary Medicine
University of Cambridge, U.K

E Murgueitio 2012

Animal Welfare

- Adequate food: without thirst and without hunger
- Comfort: without excess heat, cold, humidity
- Good Health
- Adequate expression of behaviors: rumination, rest, social activities.

Broom D. 2000



Julián Rivera CIPAV 2014


Shade and shelter for livestock from Uruguay
E Murgueitio 2014

Heat Stress

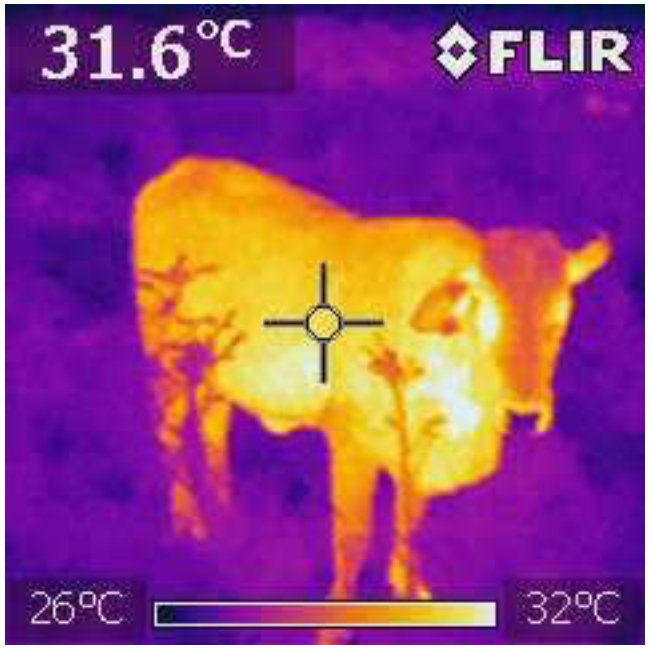
Inability of the animal to maintain its body temperature homeostasis (Broom and Molento, 2004)

It is a biological response when the animal receives a threat factor increases their body temperature above the normal range (Morberg, 2000).

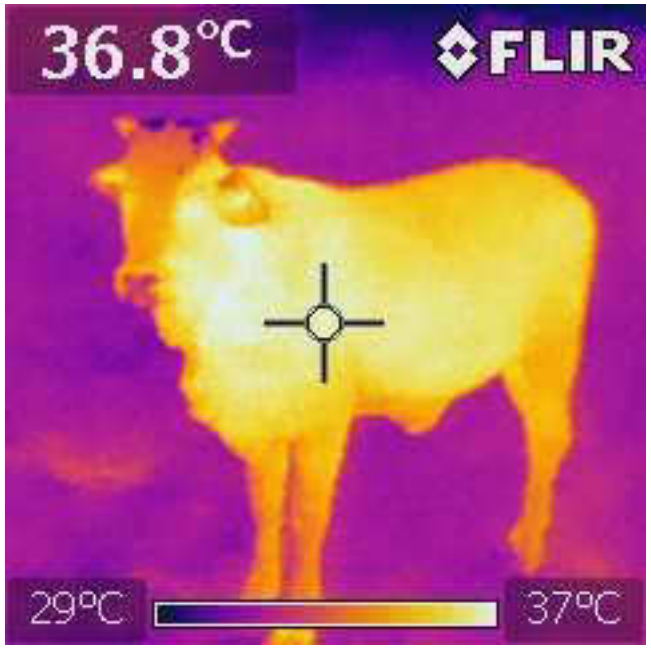
Silvopastoral systems and animal welfare

The skin temperature of cattle in thermographic images

Silvopastoral System

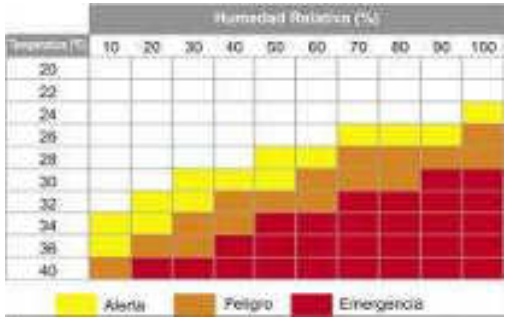


Grass monoculture



Broom D. 2015

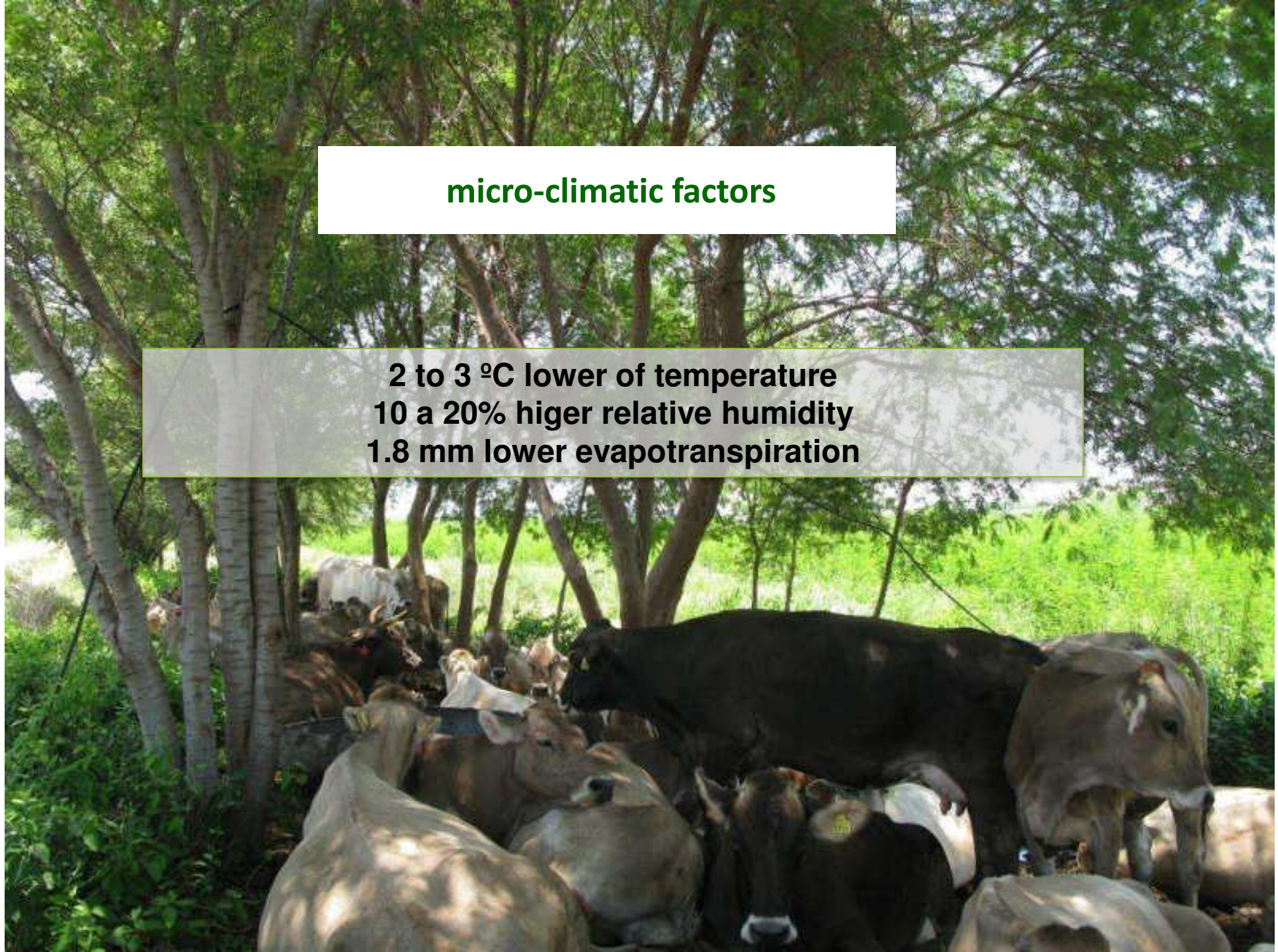
Reasons for SPS in Argentina, Brazil and Uruguay: climate change demands greater comfort for animals



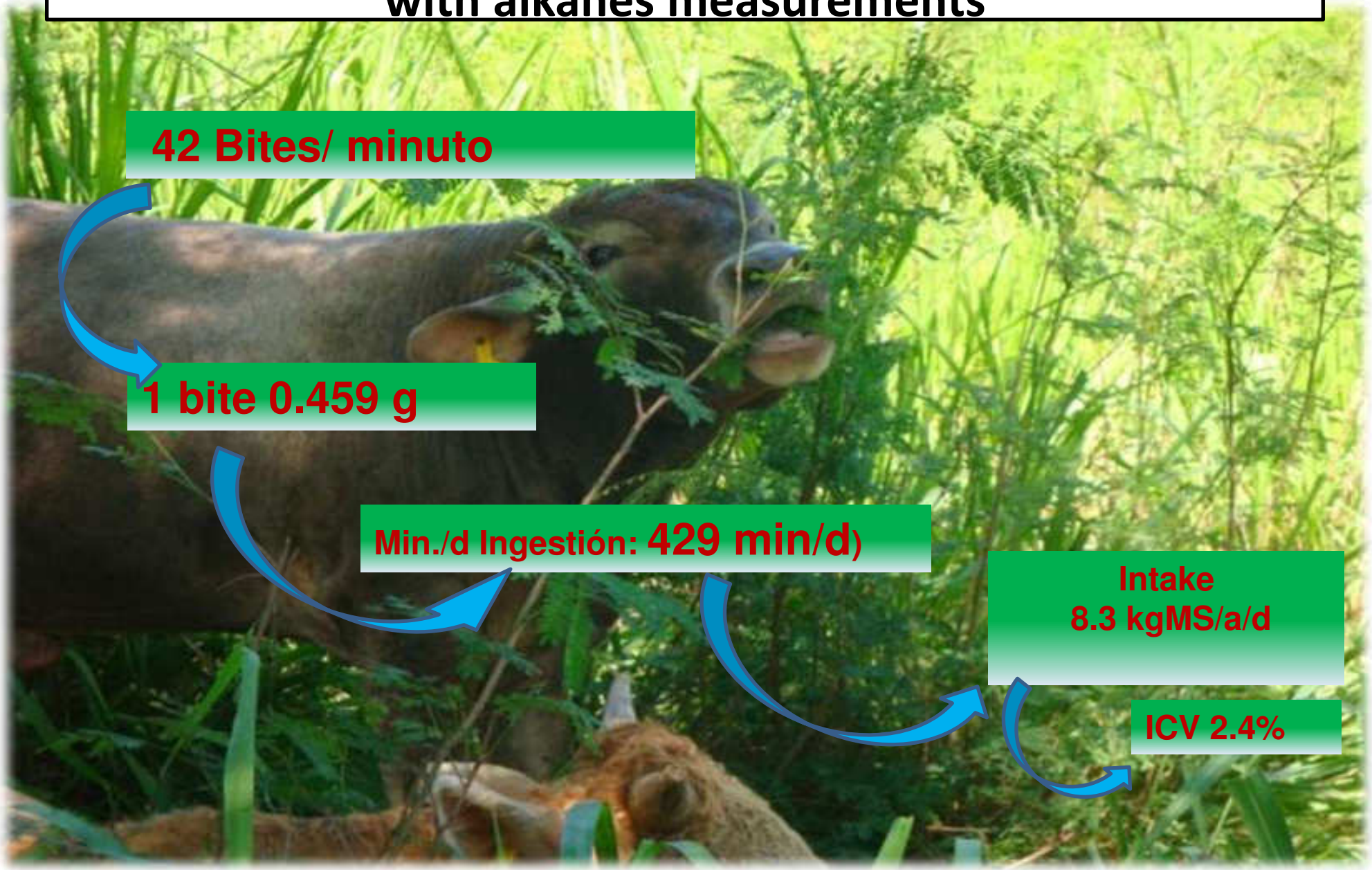
V. Da - Silva. 2015 Embrapa

Esquivel J. 2015 CREA


OUTDOOR TEMPERATURE
39 °C
48 88 %


micro-climatic factors
2 to 3 ºC lower of temperature
10 a 20% higer relative humidity
1.8 mm lower evapotranspiration

Voluntary intake and estimated intake behavior coincided with alkanes measurements



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rspb.royalsocietypublishing.org

Review

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Sustainable, efficient livestock production with high biodiversity and good welfare for animals

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[2]Departamento de Etología, Fauna Silvestre y Animales de Laboratorio (DEFSAL), Facultad de Medicina Veterinaria y Zootecnia (FMVZ), Universidad Nacional Autónoma de México (UNAM), Ciudad Universitaria, 04510 Mexico City, Mexico
[3]Fundación CIPAV, Cra. 25 No. 6-62, Cali, Colombia

What is the future for livestock agriculture in the world? Consumers have concerns about sustainability but many widely used livestock production methods do not satisfy consumers' requirements for a sustainable system. However, production can be sustainable, occurring in environments that: supply the needs of the animals resulting in good welfare, allow coexistence with a wide diversity of organisms native to the area, minimize carbon footprint and provide a fair lifestyle for the people working there. Conservation need not just involve tiny islands of natural vegetation in a barren world of agriculture, as there can be great increases in biodiversity in farmed areas. Herbivores, especially ruminants that consume materials inedible by humans, are important for human food in the future. However, their diet should not be just ground-level plants. Silvopastoral systems, pastures with

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

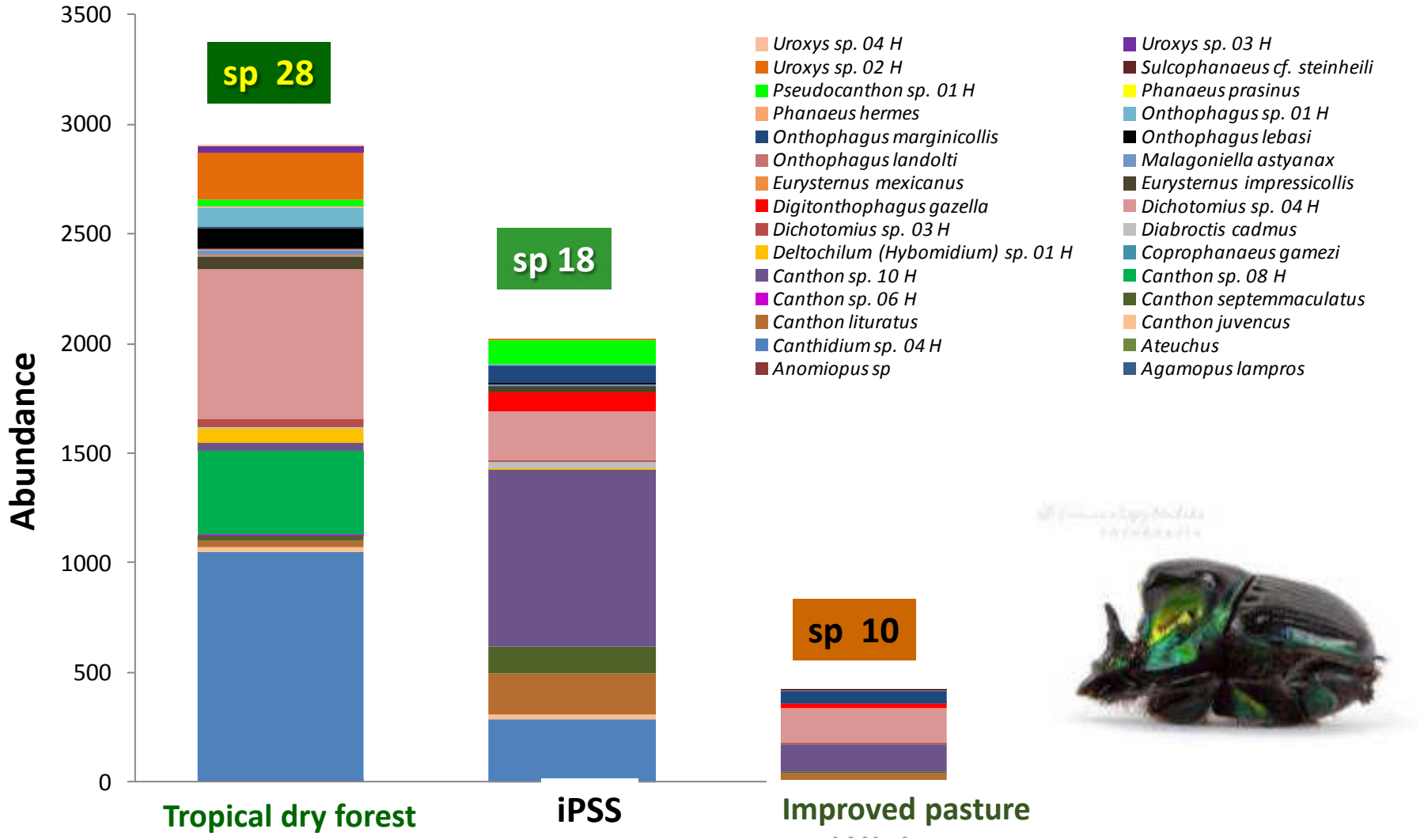
Tropical Dry Forest

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}

Livestock Blood-feeding flies

HORNFLY

Haematobia irritans

Hornfly

Reduced production of beef and milk due to stress.
Vector of several important diseases
Skin damage (abrasions, wounds scratching, secondary infection)
Anemia (28.5 mg of blood per day)
Higher production costs (insecticides)
Residual pesticide contamination.

A win-win situation

The productive advantages that make SPS attractive for landowners ultimately originate from the environmental benefits they provide.

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

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

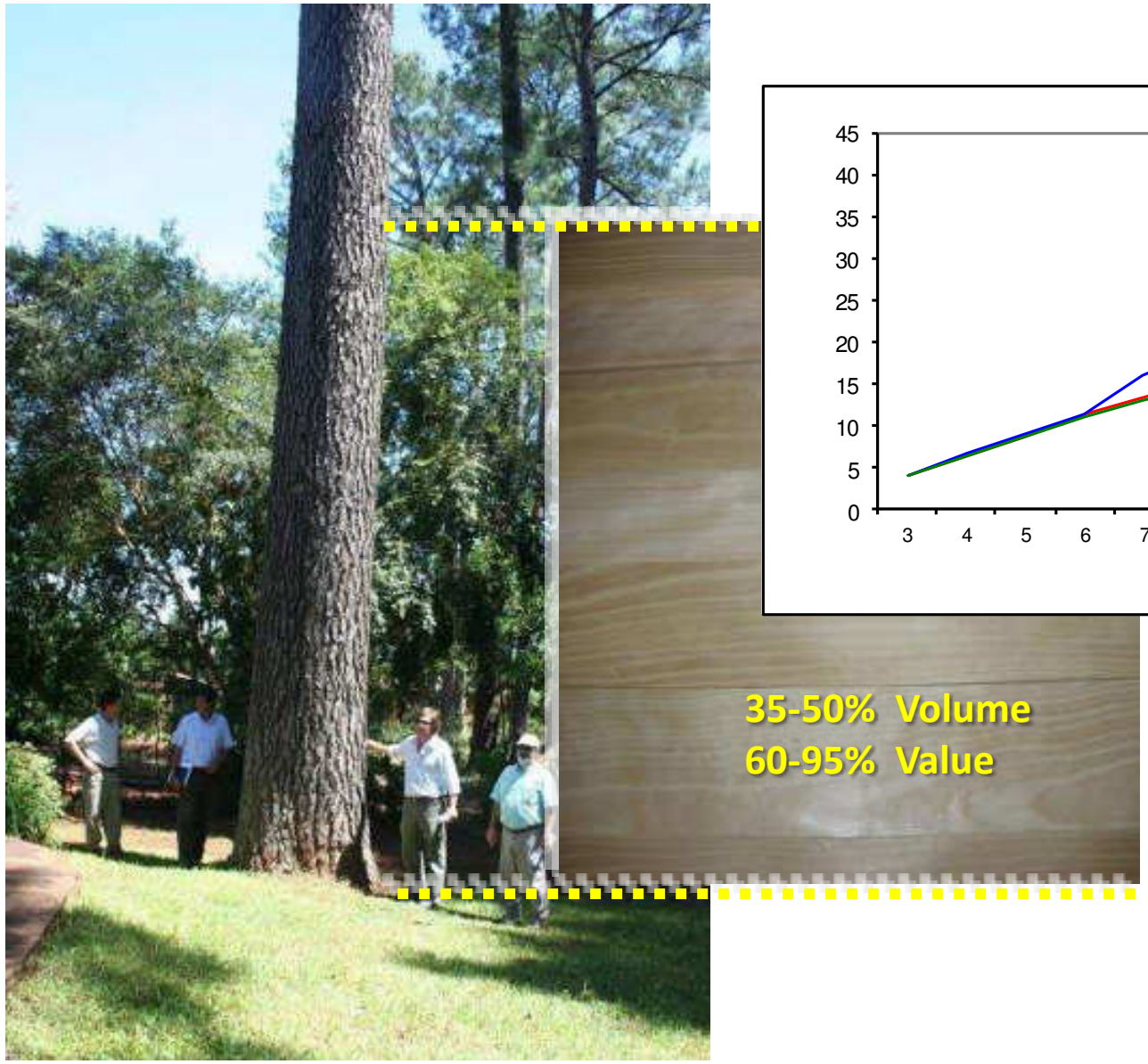
Outcome

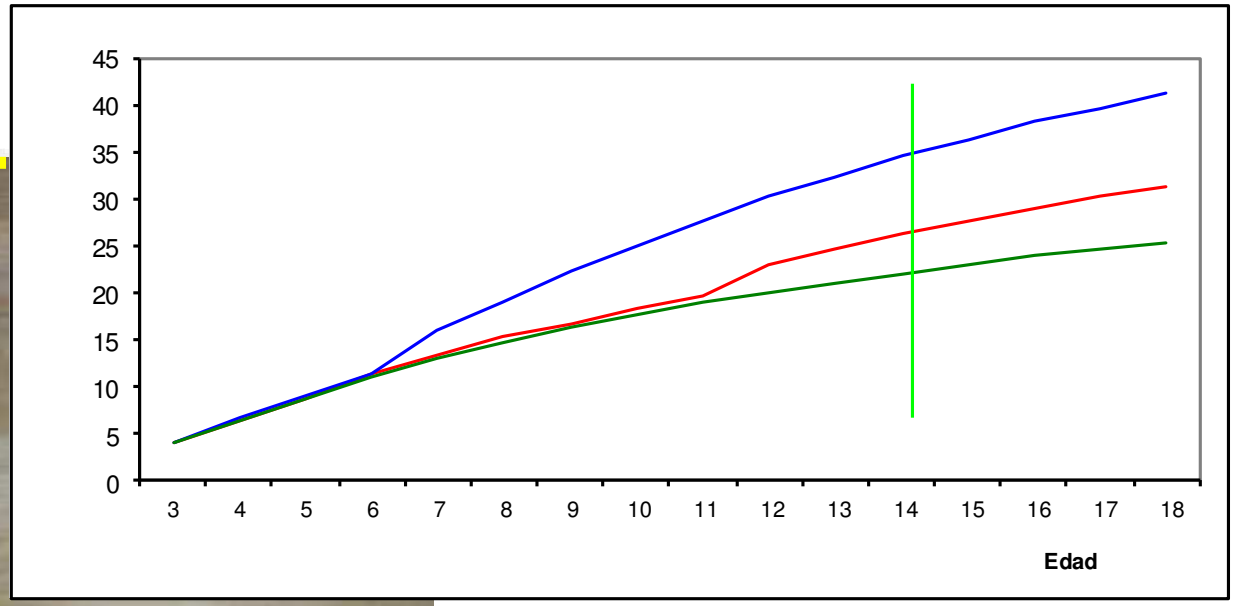
Small and medium producers entering the forestry business.

Countries

Argentina, Brazil, Colombia, Chile, Uruguay, Venezuela

Homogeneous plantation or SPS: change in diameter (cm)





SPS

Forestry

No thinning

Age (years)

Lacorte and Esquivel 2011

INTA

Large diameter trees
excellent way
and trimmed

Sawmilling and cultivate Araucaria pines for tables (plantations and SSP)
veneer, particleboard and furniture. Misiones, Argentina 2015

Fernando Uribe 2015

Wood conversion rate between SPS and pure plantation in Brazil

Data from Ivinhema, proyect MS .

Eucalipto Clon GG 100

Pure plantation

1.111 Plants/ha

AAI 4 year: 43,50 m³/ha/year.

Tree Volume = 0,1566 m³/ trees

Silvopastoril 424 Plants/ha

AAI (Average Annual Increase)

by 4º year: 33,20 m³/ha/year.

Tree volume= 0,313 m³/tree

Eng.Ftal. Celso Medeiros
citado por Da Silva 2015

Embrapa

Furniture of grown wood plantation and SPS.
Misiones, Argentina 2015

Fernando Uribe 2015

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

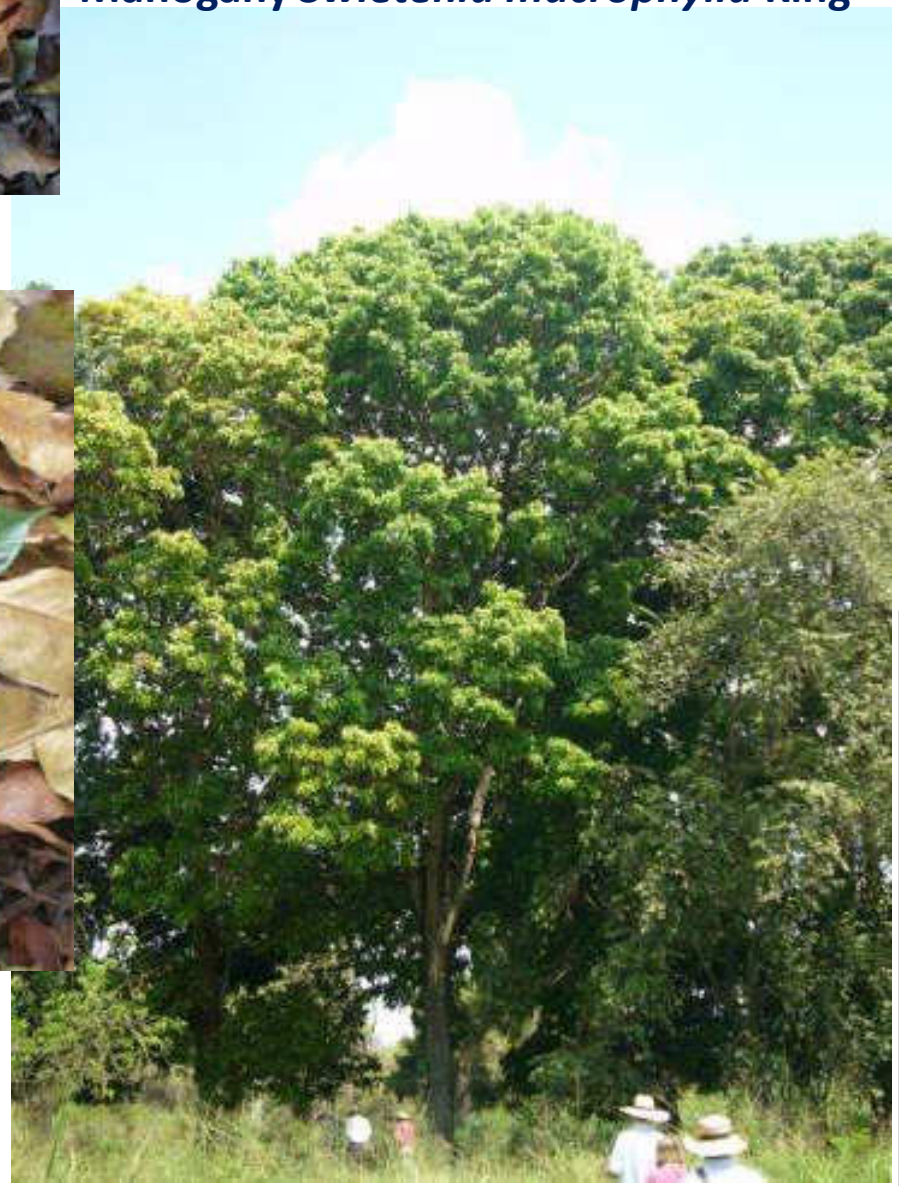
Pasture rotation without external fertilization and irrigation vs. SSPI with and without forest products
US $
Annual interest rate: 10%

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



Mahogany *Swietenia macrophylla* King

El Hatico, Colombia, 2014

New plantations Brazil.

Brancalión P. LERF 2012

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

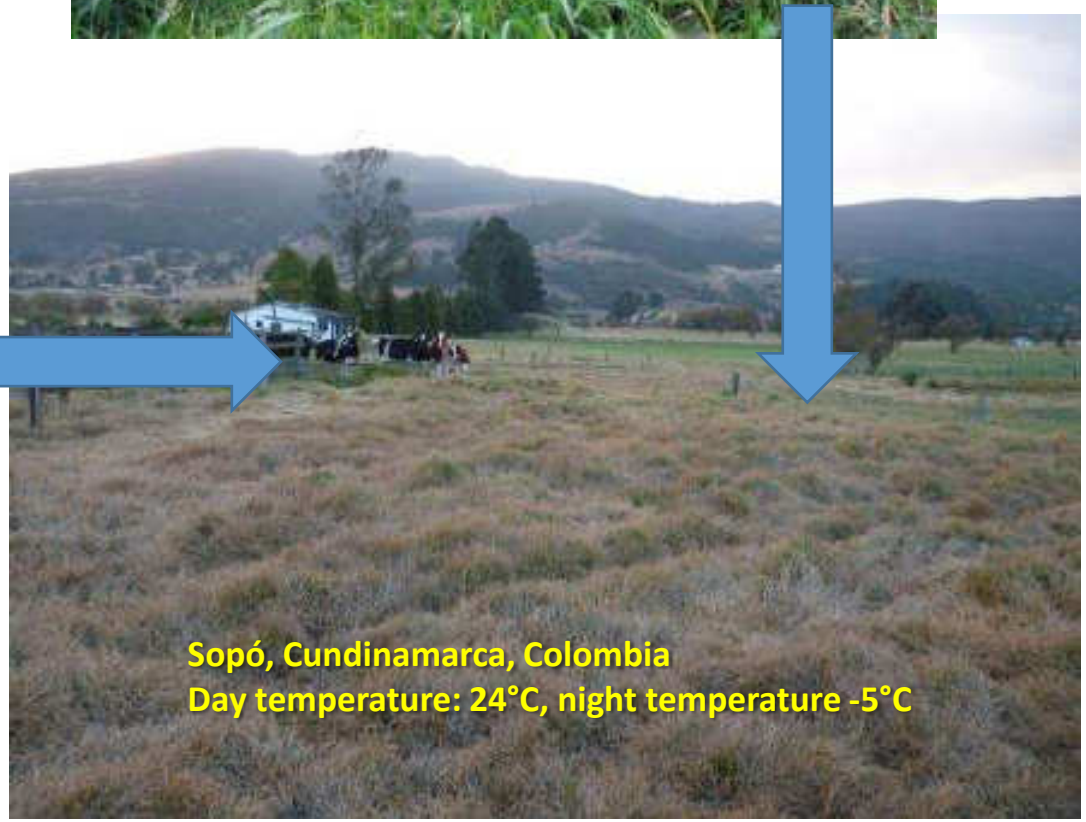
Outcome

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

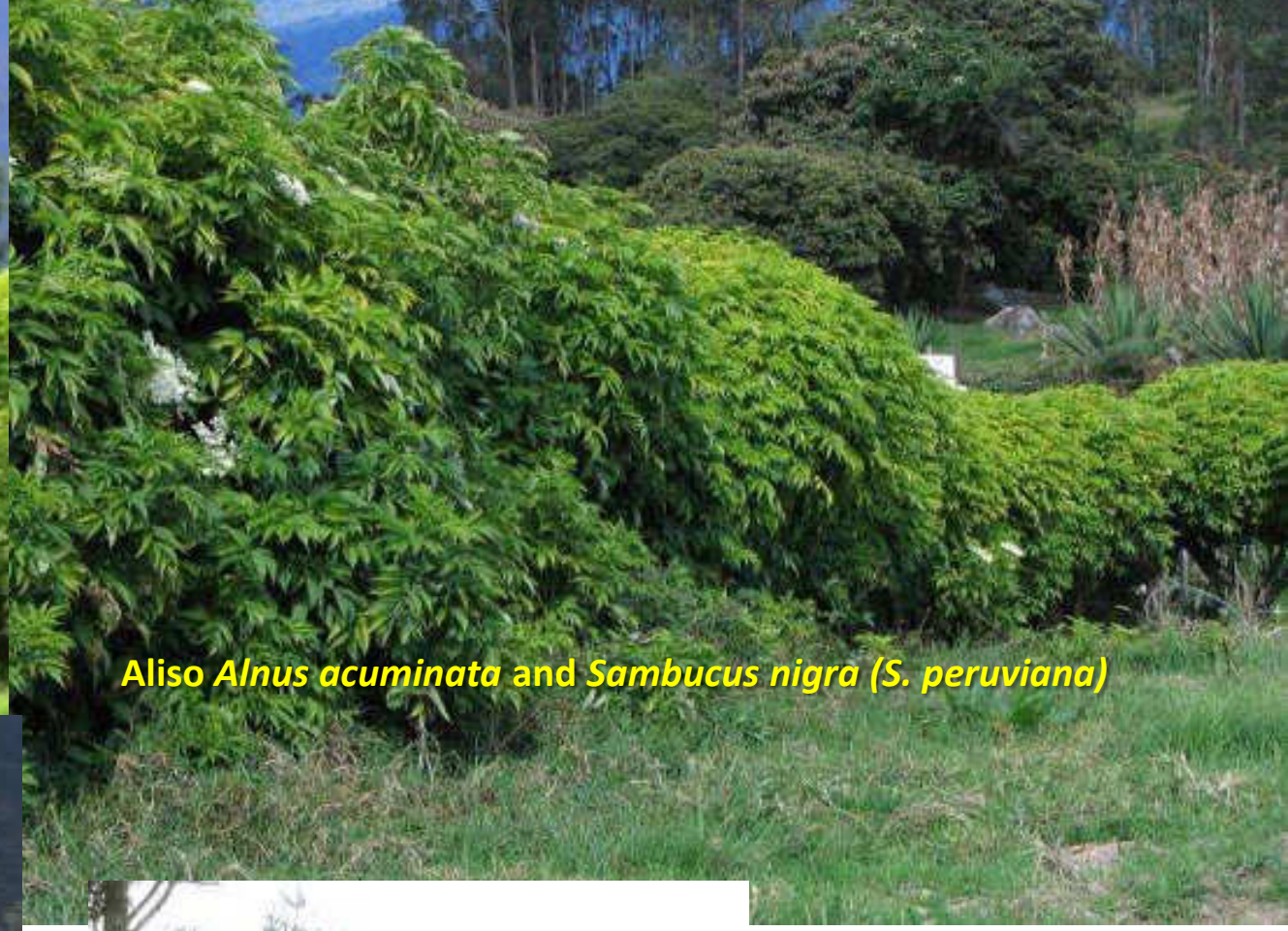
Countries

Argentina, Brazil, Colombia, Uruguay

Bogotá Plateau, Colombia.
Frost during 2009-2010 El Niño



Sopó, Cundinamarca, Colombia
Day temperature: 24°C, night temperature -5°C



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

Belén, Boyacá
Colombia.
Manuel Fajardo Fabegan 2012

***Helianthus tuberosum* Topinambur**

Chilota sheeps grazing topinambur. Chiloé - Chile.

Carlos Venegas, CET Chiloé Chile 2013


High quality beef produced in SPS
Plantar SA Walter Konkhe, Misiones - Argentina 2015
Julián E. Rivera CIPAV

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

Sustainable dairy production with Intensive Silvopastoral Systems (ISPS)

Lechería La Sofía, Bitaco (Colombia)

Dairy products as functional feed

Beneficial for human health

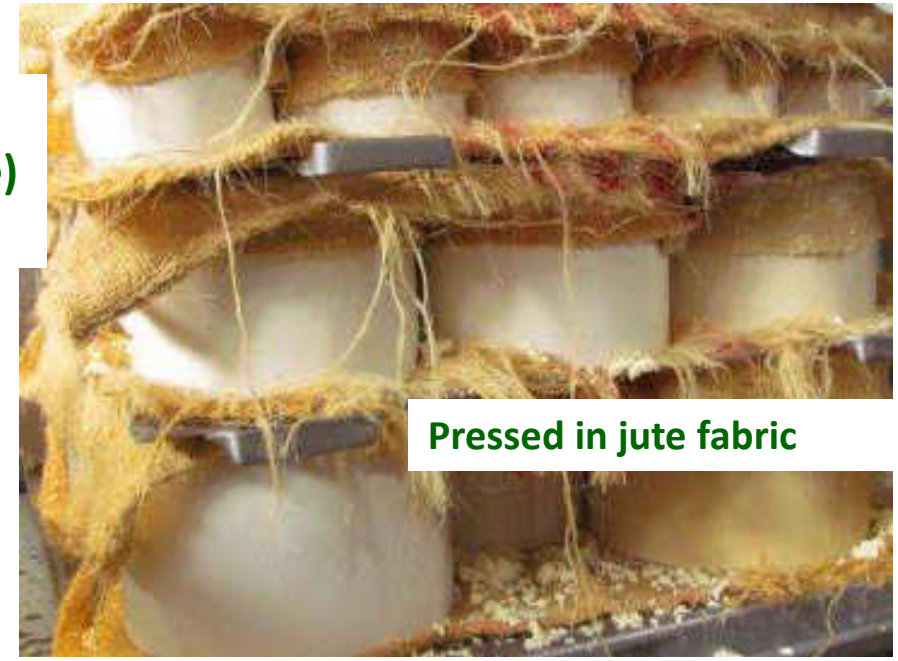
VACAS FELICES

Libres y al Pastoreo 100%

Gracile PauLeth
Sangay Quiroz 2013

Research in the fat profile, highlight the high values of unsaturated fatty acids such as conjugated linoleic acid (CLA)(Mahecha *et al.,* 2007).

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

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Native trees and shrubs for the productive rehabilitation of tropical cattle ranching lands

Enrique Murgueitio[a], Zoraida Calle[a,*], Fernando Uribe[a], Alicia Calle[b], Baldomero Solorio[c]

Unasylva 239, vol 63, 2012

Integrating forestry, sustainable cattle-ranching and landscape restoration

Z. Calle, E. Murgueitio and J. Chará

Journal of Sustainable Forestry (in press)

A Strategy for Scaling-up Intensive Silvopastoral Systems in Colombia

ZORAIDA CALLE[1], ENRIQUE MURGUEITIO[1], JULIÁN CHARÁ[1], CARLOS HERNANDO MOLINA[1, 4], ANDRÉS FELIPE ZULUAGA[2], ALICIA CALLE[3]

BRAZIL
PRESIDENCY OF THE REPUBLIC
Agriculture sector Plan

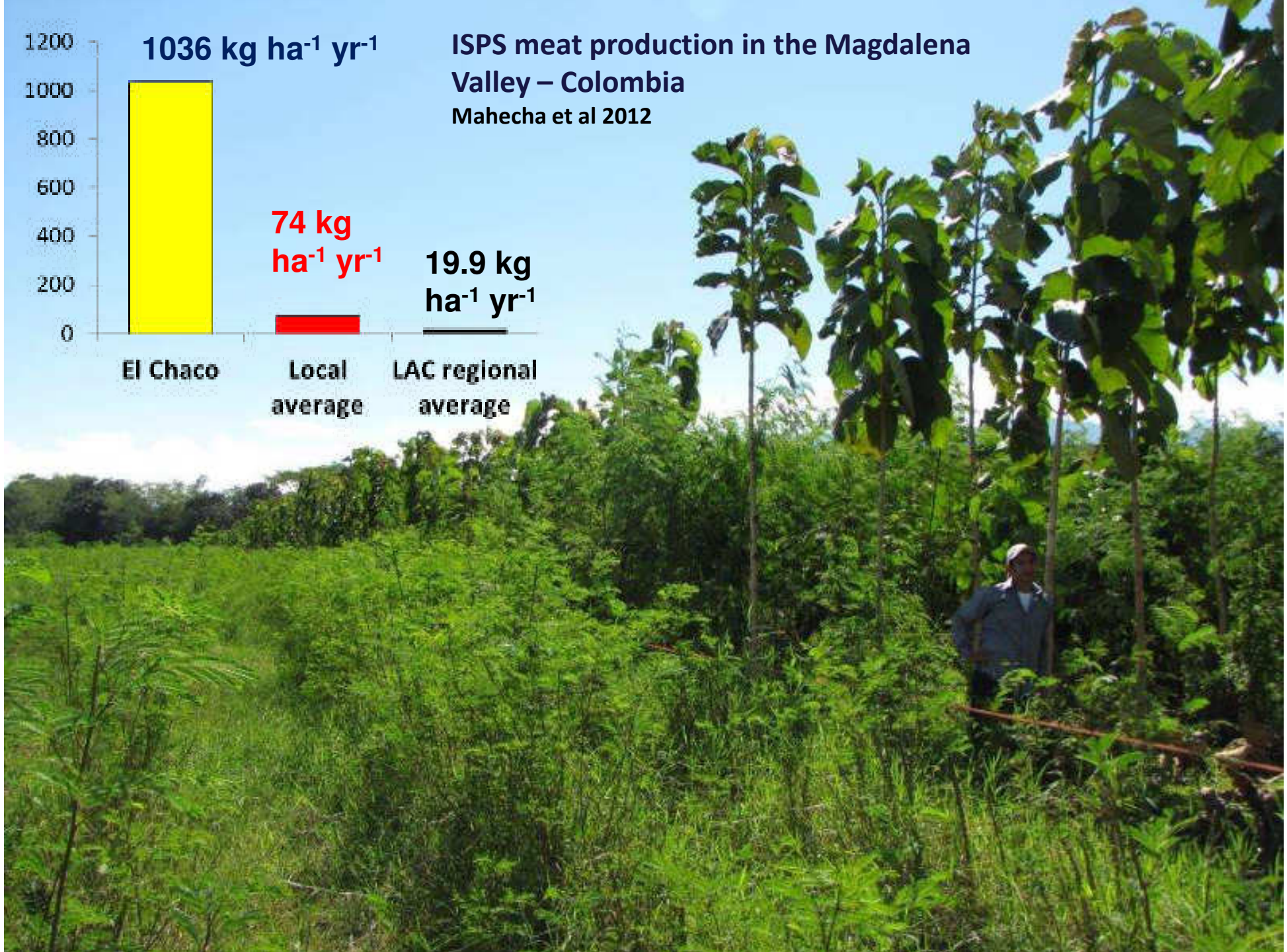
Measures to mitigate the emission of greenhouse gases

Technology	Commitment (million of hectares)
Degraded pastures recovery	**15,0**
Integrated crop-livestock-forest	**4,0**
Direct tillage system	**8,0**
Biological Nitrogen Fixation	**5,5**
Planted forests (excluding Brazil's commitment with the steel industry)	**3,0**
Animal waste treatment	**4,4**

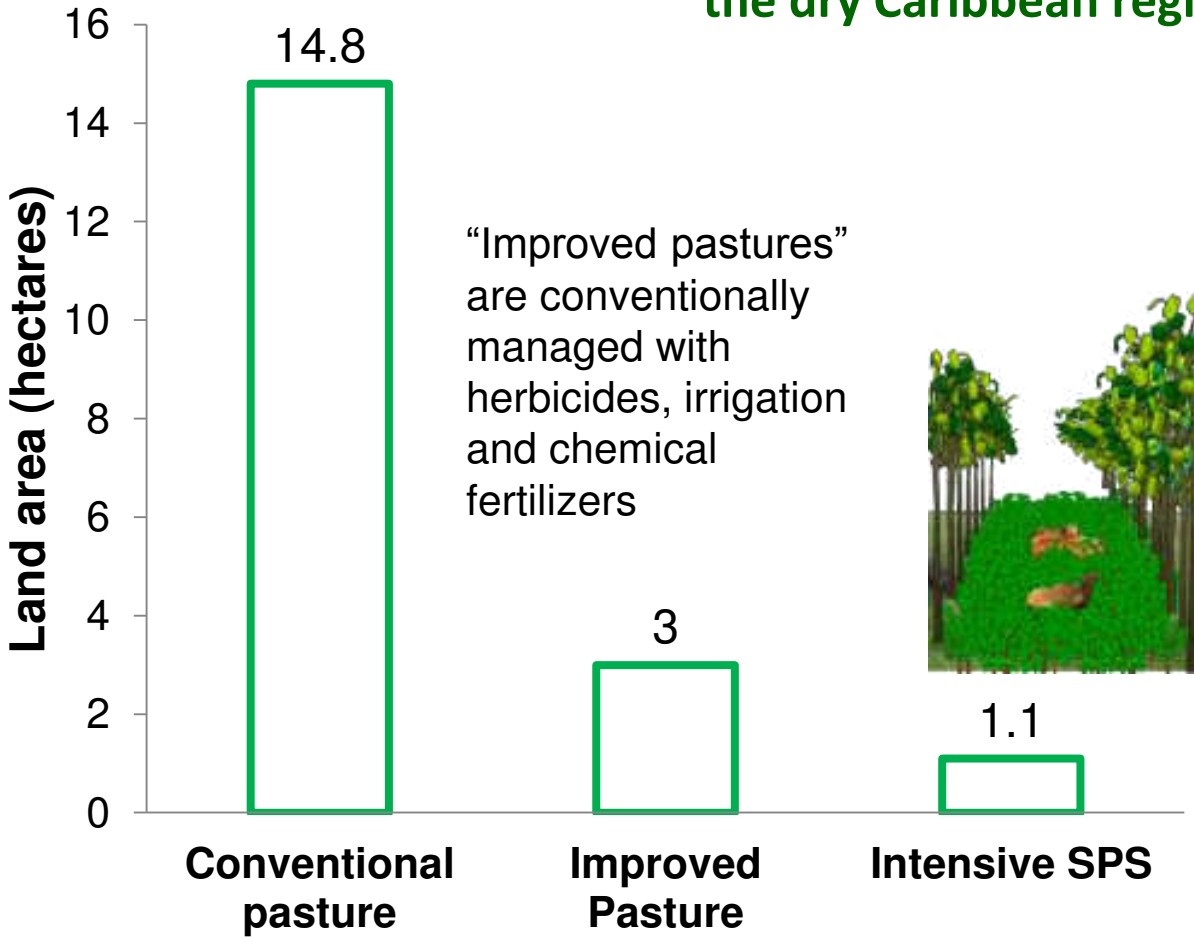
Source: MRE (2010) – nota nº 31 – 29/01/2010

► **Reducing greenhouse gases emissions between 36.1% and 38.9% for 2020**

Da Silva 2015

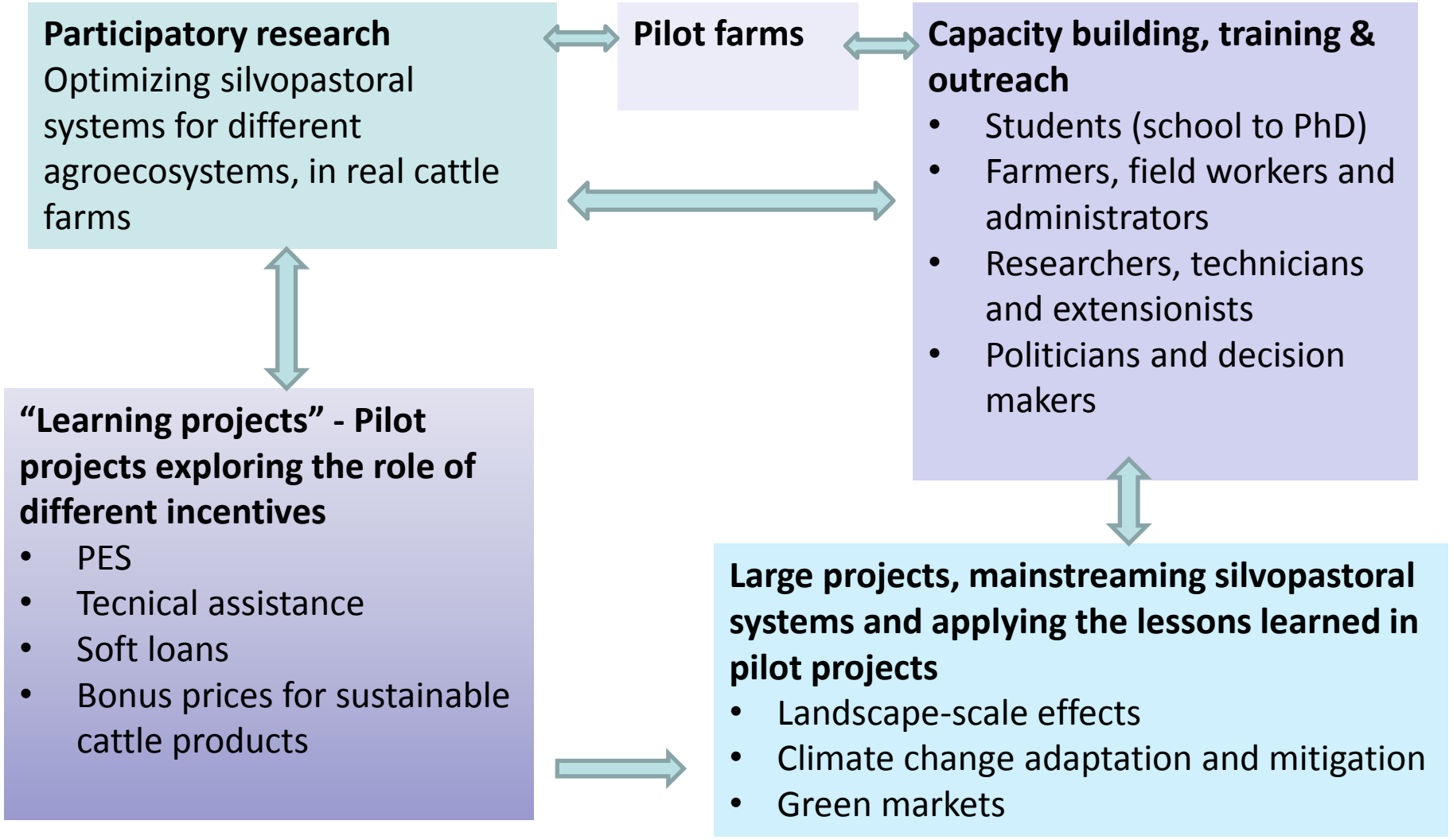

ISPS meat production in the Magdalena Valley – Colombia
Mahecha et al 2012
1200
1000
800
600
400
200
0
1036 kg ha-1 yr-1
74 kg ha-1 yr-1
19.9 kg ha-1 yr-1
El Chaco
Local average
LAC regional average

Land area required to produce 1 ton of beef yr^{-1} in the dry Caribbean region of Colombia (ha)



"Improved pastures" are conventionally managed with herbicides, irrigation and chemical fertilizers

Strategy for scaling-up SPS

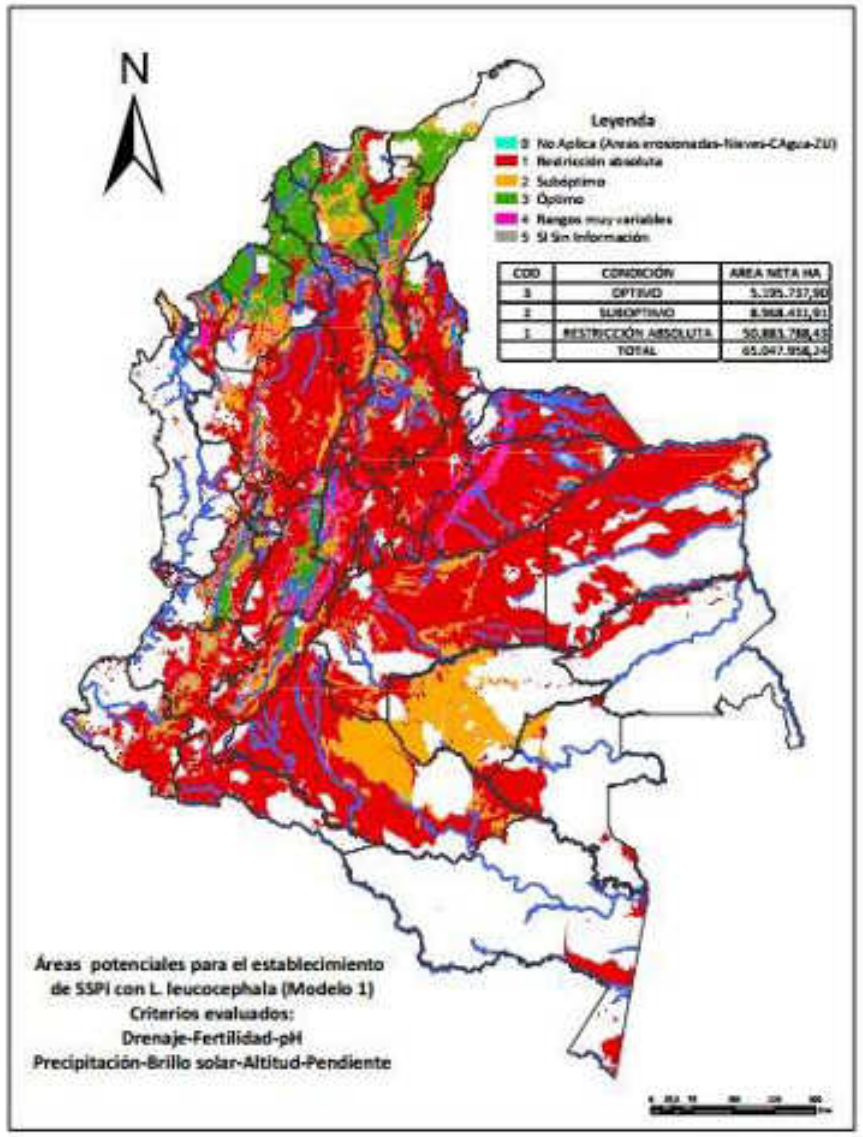


Calle et al 2012

Potential areas for ISPS with *Leucaena leucocephala*
Colombia 2015

Clima y Sector Agropecuario Colombiano
Adaptación para la Sostenibilidad Productiva

PROSPERIDAD PARA TODOS CIAT



2014 drought in Colombia

Losses for the Livestock Sector

Weight loss of animals: US$ 2.65 millions

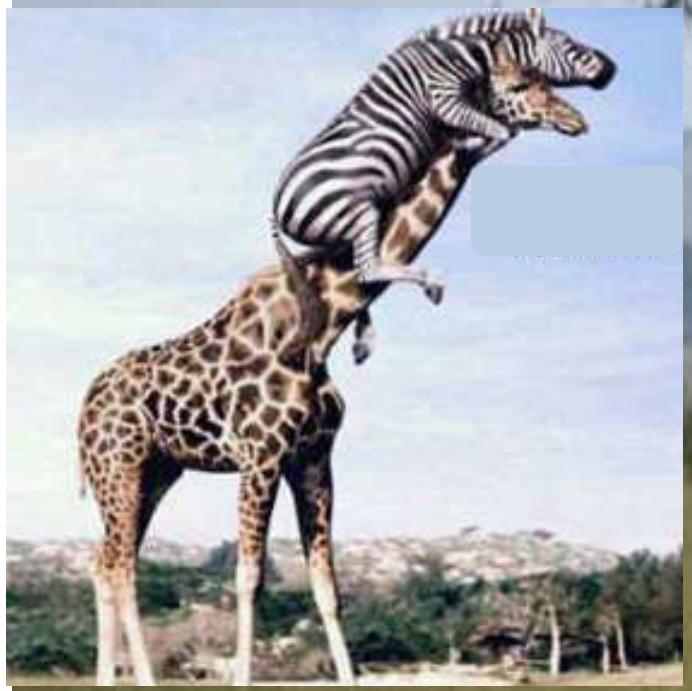
Decreased milk production: USS 19 millions

Loss of fertility in cows: US$ 59.5 millions

Soil and pasture degradation: US$ 32 millions

JF Lafaurie FEDEGAN 2014

Nopal fodder Bank, adapted Leucaena and Prosopis to semi-arid areas. Northeastern Dominican Republic. **J J. Lopera, CIPAV 2015**



La técnica es el esfuerzo para ahorrar esfuerzo

José Ortega y Gasset

The technique is the best way to do more with less

José Ortega y Gasset