

A Social-Economic-Environmental Framework for Land Degradation

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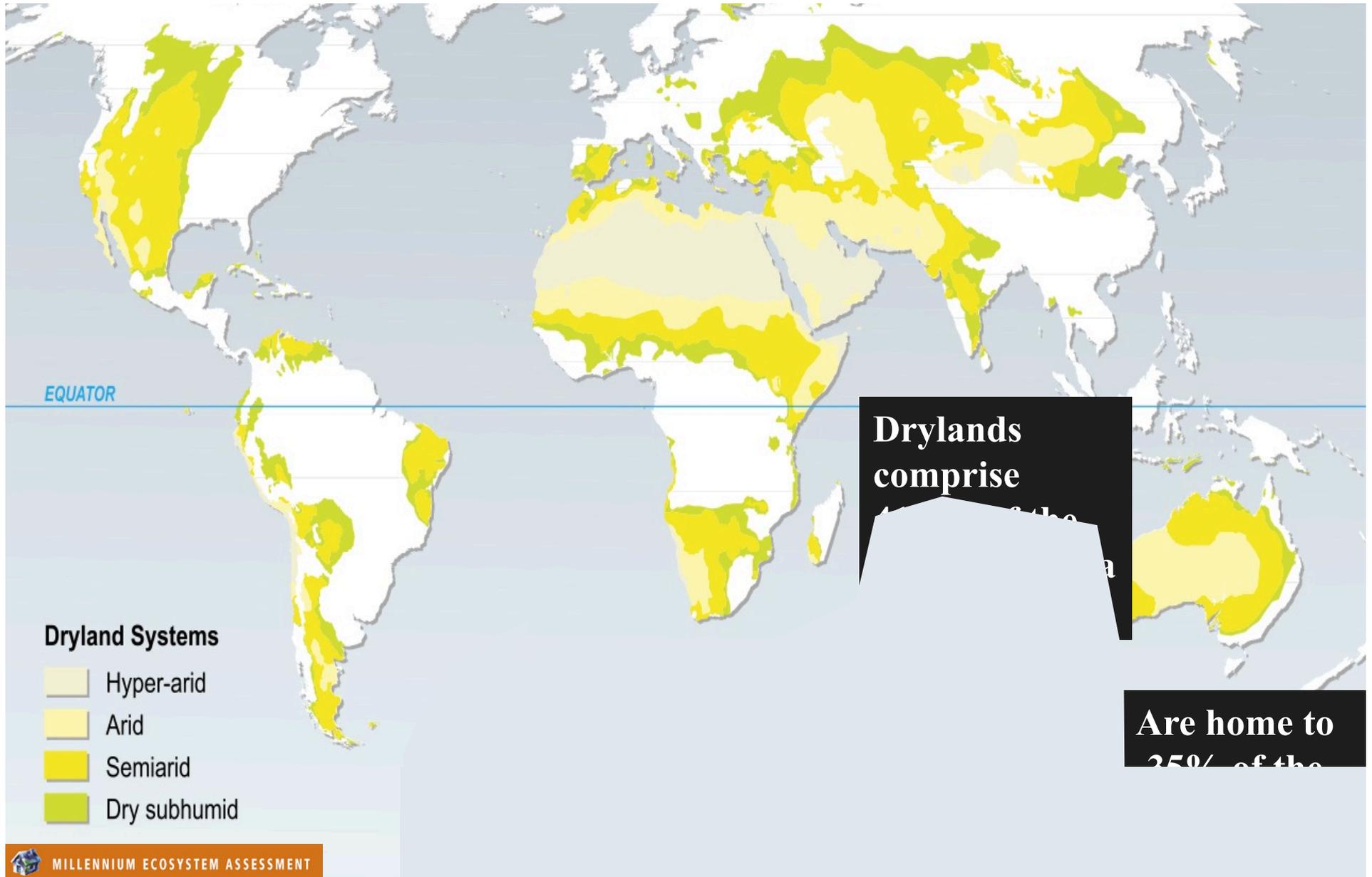
University Botanical Garden, Maseno University, February 19, 2014



Bayceer



Arid, semi-arid and dry sub-humid regions are collectively called
DRYLANDS



How often does topic of *desertification* appear in 2 of the world's leading journals?

Key covers period July 1996 – June 2006

		Science		nature	
		Titles	Title and / or abstract	Title	Title and / or abstract
		CLIMATE 'climate change' (and its variants)			
		BIODIVERSITY 'biodiversity' (or 'biological diversity')			
		DESERTIFICATION 'desertification'			

Why is this ?

We argue that, in part, it's the absence of a *focused international science program*



2013 Año Internacional
Un futuro sembrado
hace miles de años



Altiplano (Andes High Plains)





Quinoa (*Chenopodium quinoa* Willd.)



- **Native → Andes of Bolivia, Chile, Peru**
- **“Mother Grain” in the Inca language**
- **Major crop of the pre-Columbian cultures**
- **“Inca rice” → eaten > 5,000 yrs**
- **Traditional staple of diet**



Foto N° 15: Cultivo de quinua en laderas rocosas. Se trata de pequeñas parcelas de cultivo



Foto N° 16: Siembra tradicional de la quinua en la región de Salinas de Garci Mendoza con el instrumento denominado Taquiza, elaborado por los mismos campesinos del lugar.

Pseudocereas
>120 varieties known



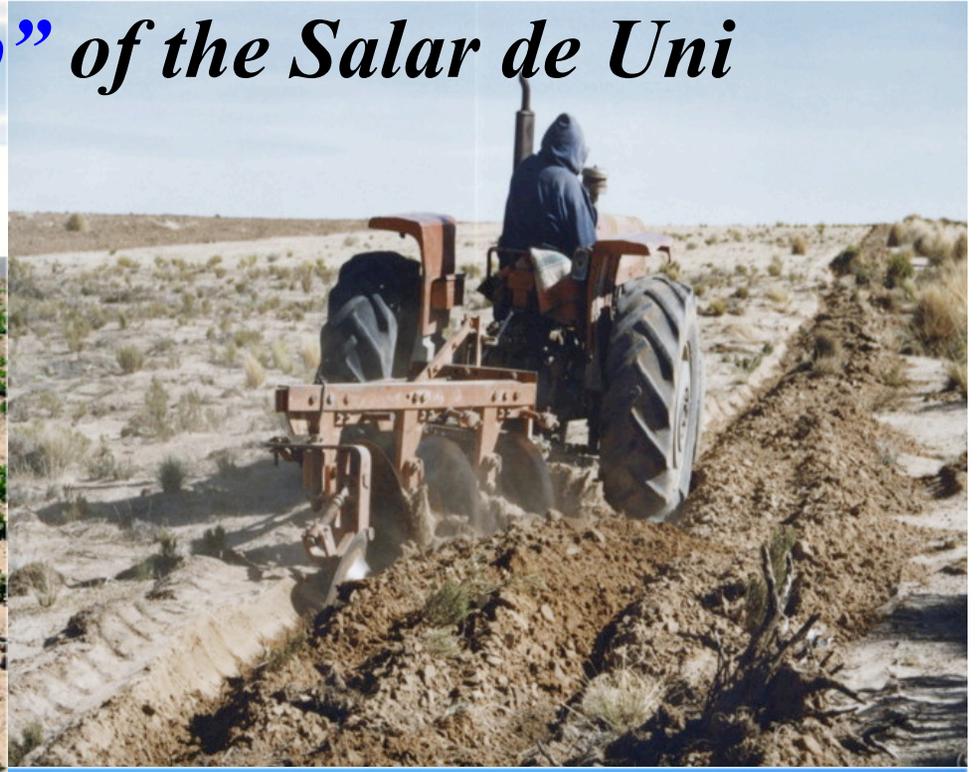
Salar de Uyuni in southern Bolivia

- world's largest salt flat: 10,582 km²
- ~3,700 m elevation





The “Great Plow-up” of the Salar de Uni





Organic stores
in USA & Europe



DEMAND

NGOs, USAID, etc



Profits





DRYLAND DEVELOPMENT PARADIGM (DDP)

Global Desertification: Building a Science for Dryland Development

James F. Reynolds,^{1*} D. Mark Stafford Smith,² Eric F. Lambin,³ B. L. Turner II,⁴ Michael Mortimore,⁵ Simon P. J. Batterbury,⁶ Thomas E. Downing,⁷ Hadi Dowlatabadi,⁸ Roberto J. Fernández,⁹ Jeffrey E. Herrick,¹⁰ Elisabeth Huber-Sannwald,¹¹ Hong Jiang,¹² Rik Leemans,¹³ Tim Lynam,¹⁴ Fernando T. Maestre,¹⁵ Miguel Ayarza,¹⁶ Brian Walker²

In this millennium, global drylands face a myriad of problems that present tough research, management, and policy challenges. Recent advances in dryland development, however, together with the integrative approaches of global change and sustainability science, suggest that concerns about land degradation, poverty, safeguarding biodiversity, and protecting the culture of 2.5 billion people can be confronted with renewed optimism. We review recent lessons about the functioning of dryland ecosystems and the livelihood systems of their human residents and introduce a new synthetic framework, the Drylands Development Paradigm (DDP). The DDP, supported by a growing and well-documented set of tools for policy and management action, helps navigate the inherent complexity of desertification and dryland development, identifying and synthesizing those factors important to research, management, and policy communities.

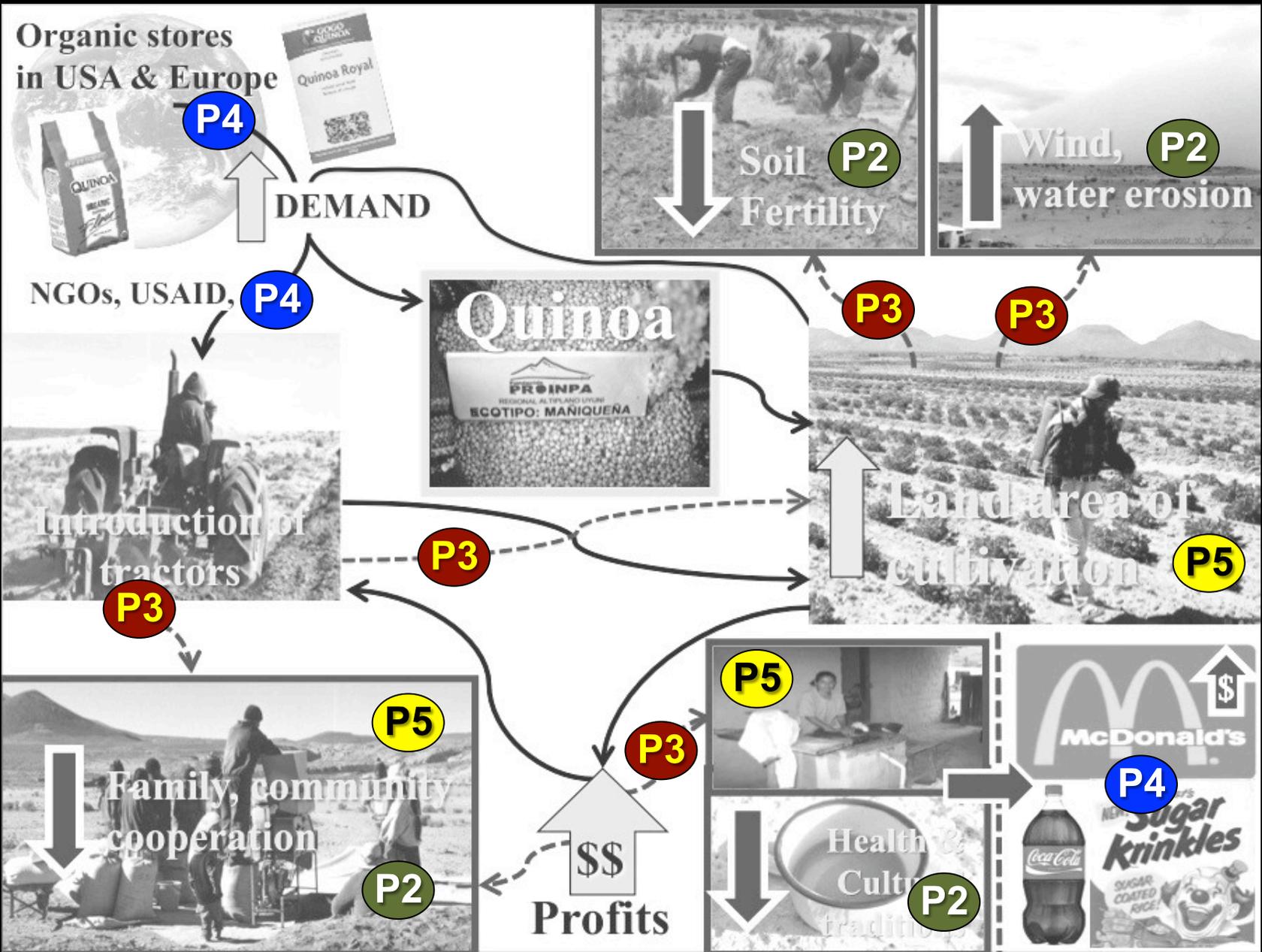
Drylands cover about 41% of Earth's land surface and are home to more than 38% of the total global population of 6.5 billion (1, 2). Some form of severe land degradation is present on 10 to 20% of these lands [medium-confidence conclusion of (2)] (3), the consequences of which are estimated to affect directly some 250 million people in the developing world,

an estimate likely to expand substantially in the face of climate change and population growth (4). The United Nations has periodically focused on desertification and drylands, notably adopting the Convention to Combat Desertification (CCD) in 1992 (3) and designating 2006 as the International Year of the Desert and Desertification.

One contribution of the CCD was to enshrine a definition of desertification as "land deg-



P1

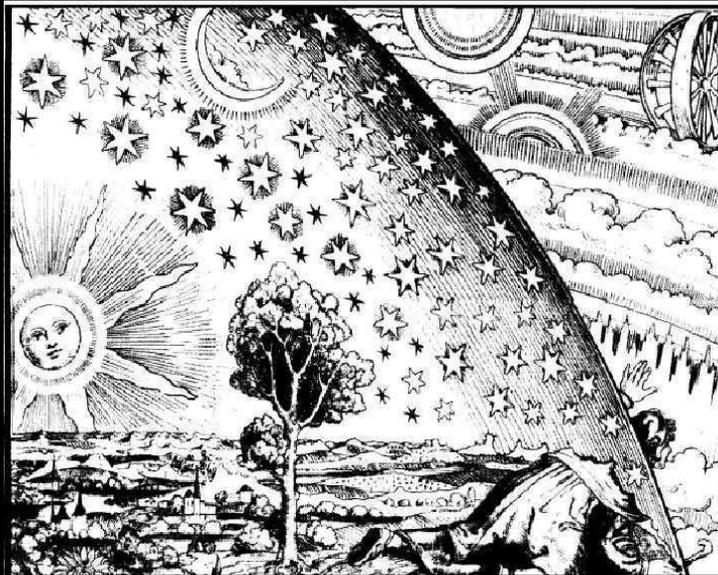


Reynolds JF, et al. (2007) Global desertification: Building a science for dryland development. *Science*, 316(5826), 847-851. doi: 10.1126/science.1131634

STEP 1: INTEGRATED FRAMEWORK

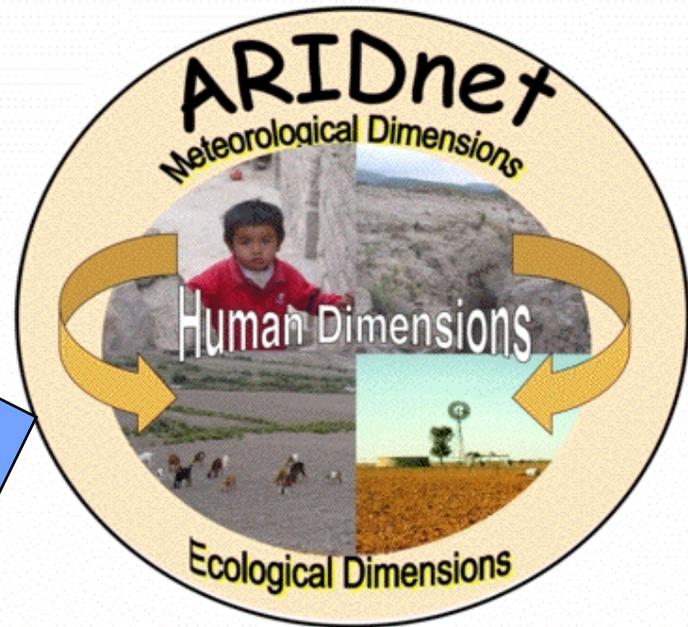
Drylands
Development
Paradigm
(*DDP*)

Global Desertification: Do Humans Cause Deserts?



James F. Reynolds
and
Mark Stafford Smith [eds]

Dahlem University Press
Berlin, Germany



(Assessment, Research,
and Integration on Desertification
network)

International network of researchers
(case studies: stakeholders)

One Goal:

classify what matters, where, and why

ARIDnet - Americas

Tri-City Border:
(Las Cruces, El Paso, Juarez)



La Amapola,
MEXICO



La Sepultura
(Chiapas) MEXICO



Quesungual (Santa Rosa, Guarita,
Candelaria ,Lempira) HONDURAS



Salar de Uyuni,
BOLIVIA



Región de
Coquimbo, CHILE



Huasteca Sur, Sierra Madre
Oriental (Huichihuayan),
MEXICO



Nochixtlán (Mixteca
Alta), MEXICO



El Alto Patía
COLOMBIA



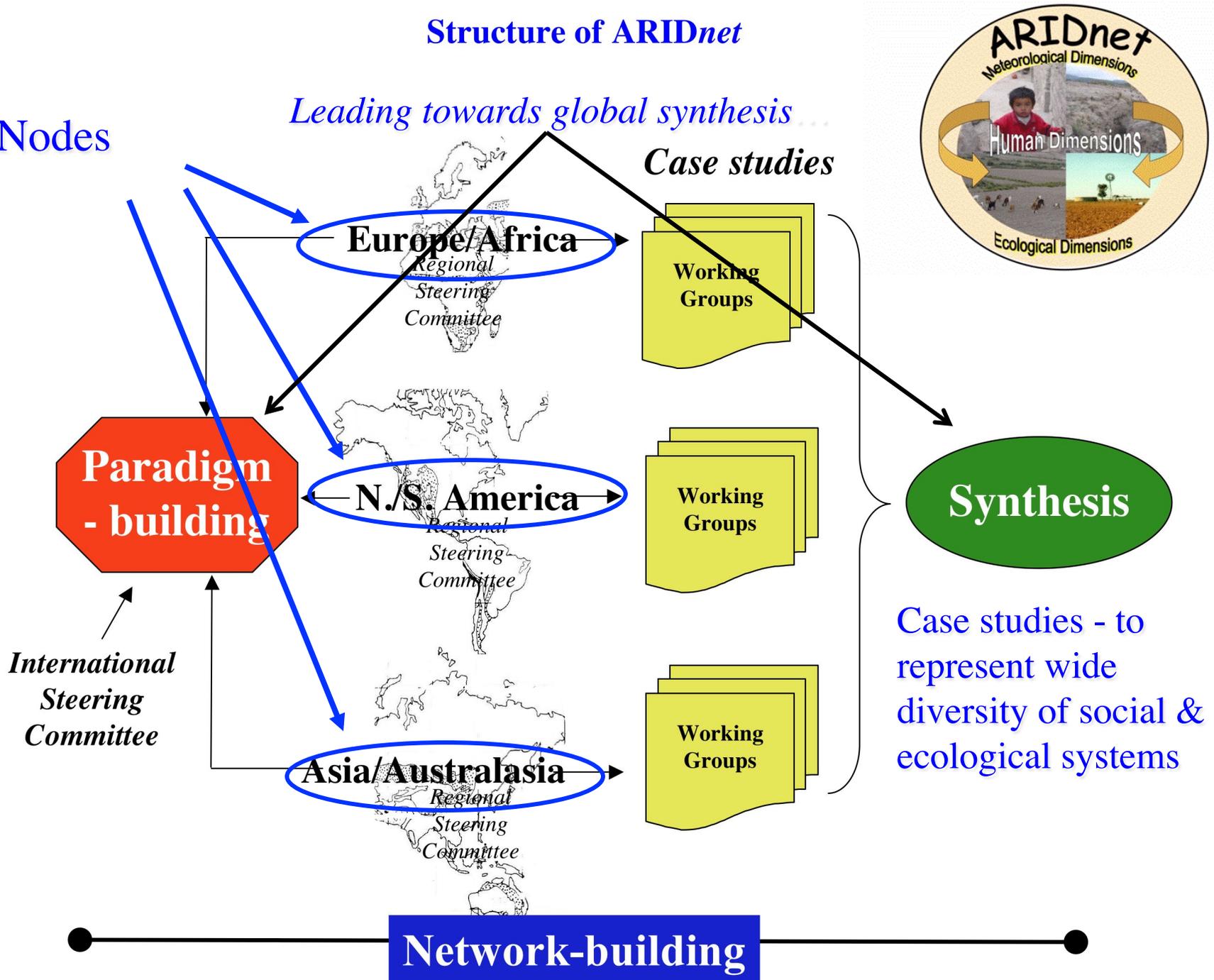
The San Luis (Villa
Mercedes), Central
ARGENTINA



Structure of ARIDnet

3 Nodes

Leading towards global synthesis...



Am I evolving?



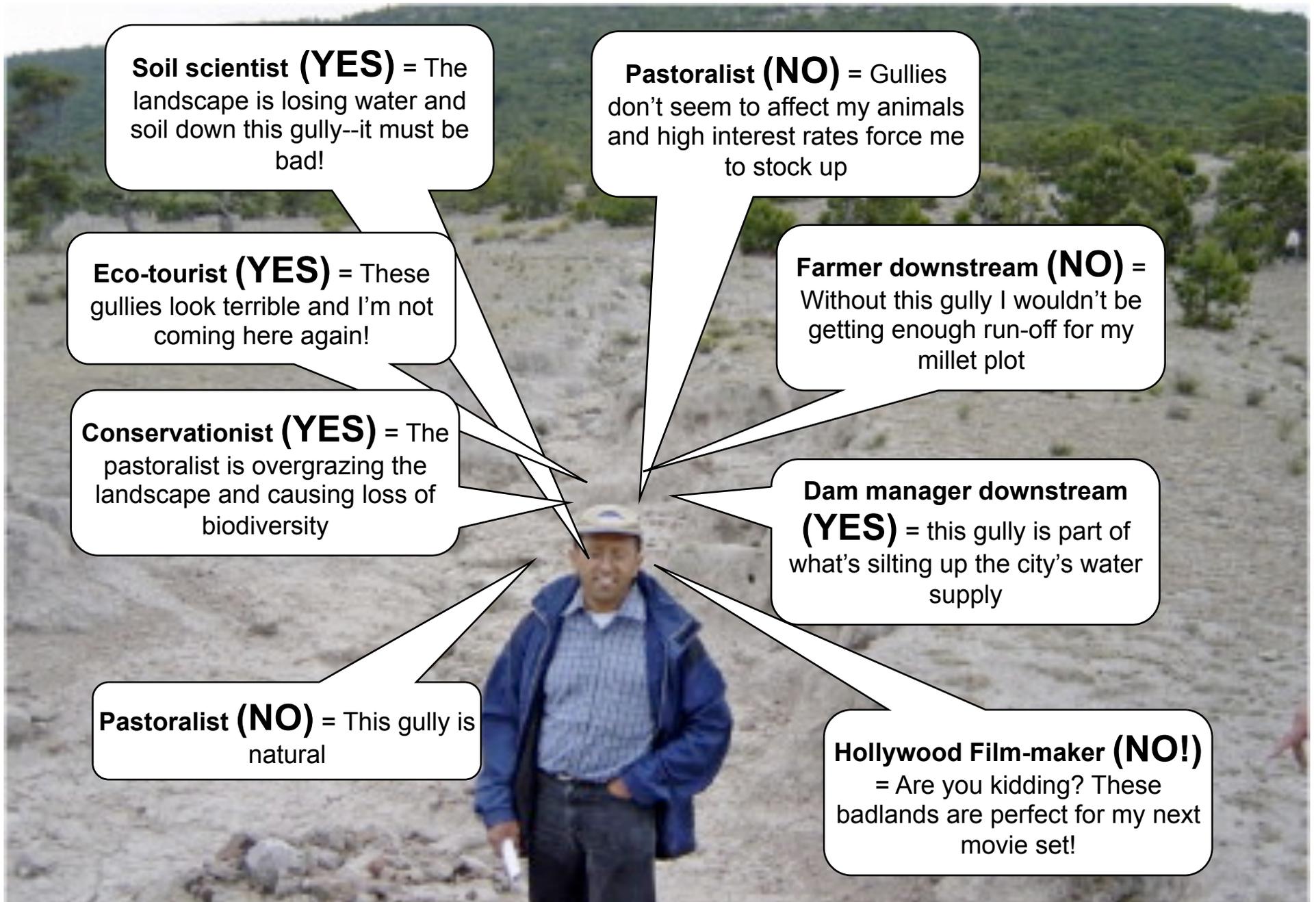


Ecological Perspective

- **Overgrazing**
- **Soil fertility**
- **Biogeochemical cycles**
- **Biodiversity**
- **Primary production**
- **Secondary production**

Social-Economic Perspective:

- **Livelihoods**
- **Land tenure**
- **Poverty**
- **Markets**
- **Land use/change**
- **Culture**



Soil scientist (YES) = The landscape is losing water and soil down this gully--it must be bad!

Pastoralist (NO) = Gullies don't seem to affect my animals and high interest rates force me to stock up

Eco-tourist (YES) = These gullies look terrible and I'm not coming here again!

Farmer downstream (NO) = Without this gully I wouldn't be getting enough run-off for my millet plot

Conservationist (YES) = The pastoralist is overgrazing the landscape and causing loss of biodiversity

Dam manager downstream (YES) = this gully is part of what's silting up the city's water supply

Pastoralist (NO) = This gully is natural

Hollywood Film-maker (NO!)
= Are you kidding? These badlands are perfect for my next movie set!

Is this landscape degraded? Let's ask the stakeholders



- **Tolerance to frost, salinity and drought**
- **Can be grown on marginal soils**



Quinoa (*Chenopodium quinoa* Willd.)



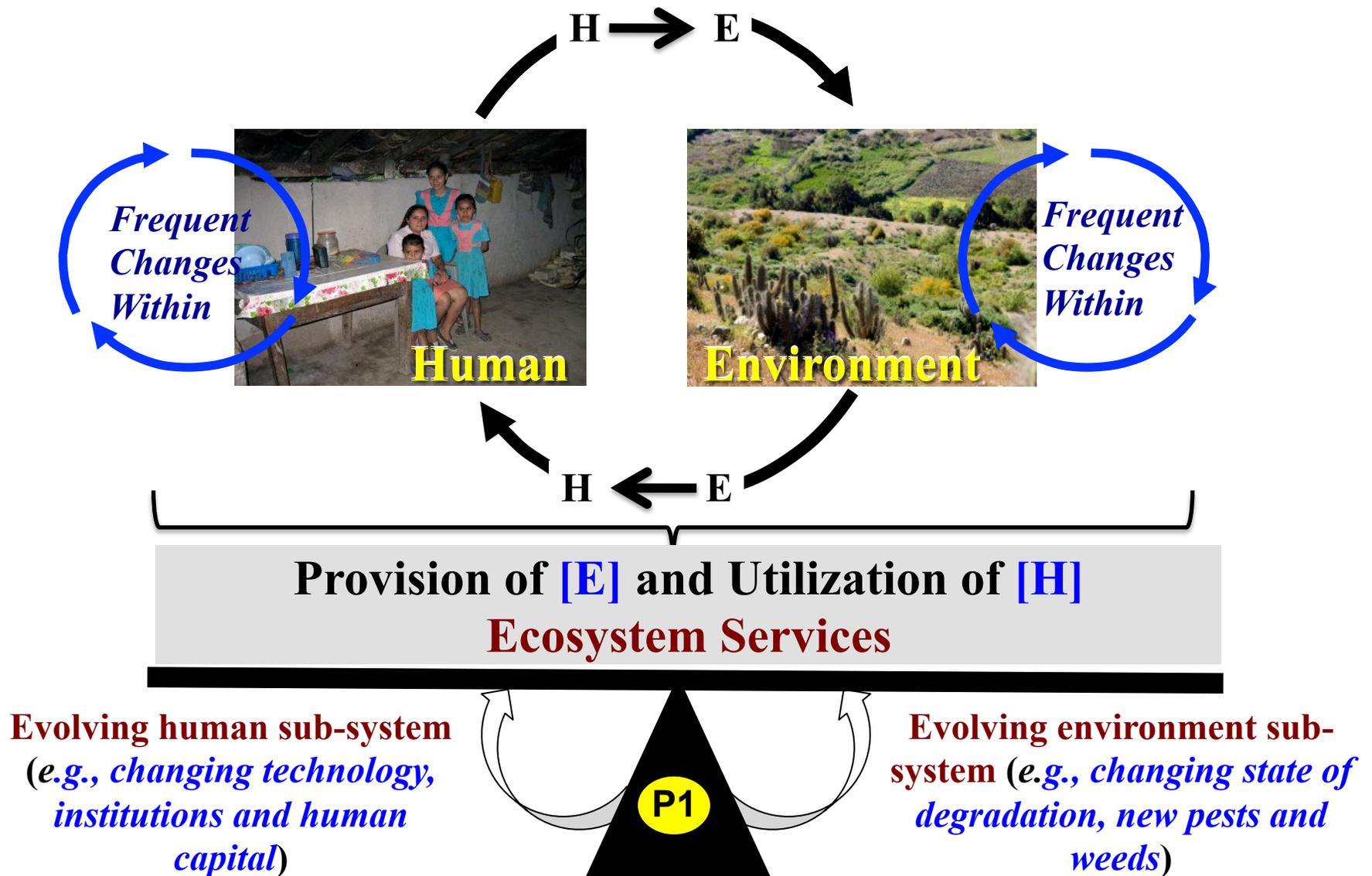
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2013 Google
US Dept of State Geographer
Image Landsat

Google earth

[Tour Guide](#)

19°53'10.87" S 64°51'30.50" W eye alt 7786.87 mi

Drylands Development Paradigm [DDP]: Consists of 5 Principles



Part I: Land Degradation & Desertification

Ecosystem Services

All life on Earth depends on a host of goods and services that ecosystems provide.



Pollinator



Water purification



Flood damage control



Forest carbon sequestration

Provisioning Services

Food
Water
Wood

Regulating Services

Climate
Floods
Diseases

Cultural Services

Aesthetic
Spiritual
Recreation

Supporting Services

Soils, nutrients, growth



HUMAN WELL-BEING

Freedom and choice

Basic material, income

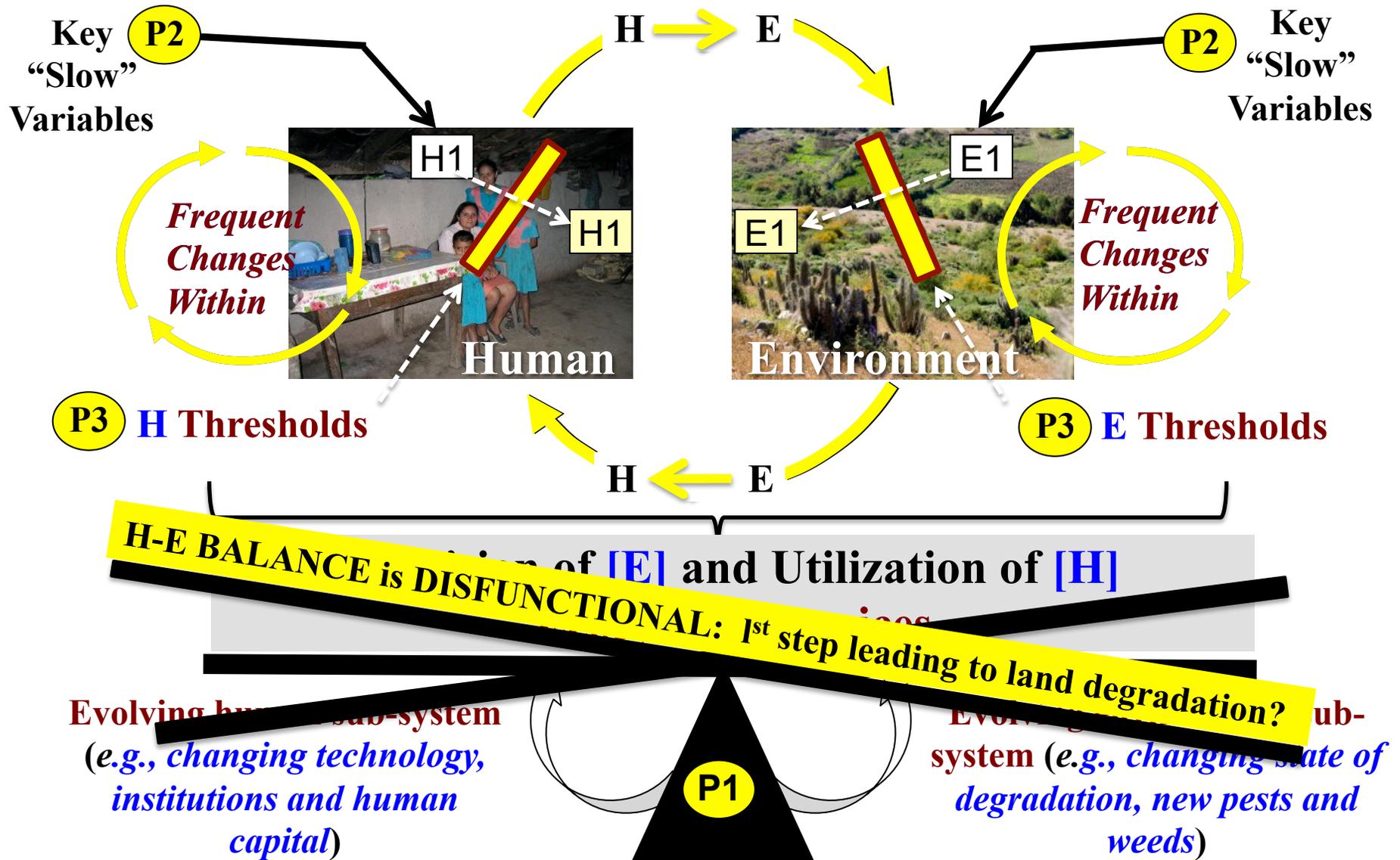
Health, nutrition

Good social relations

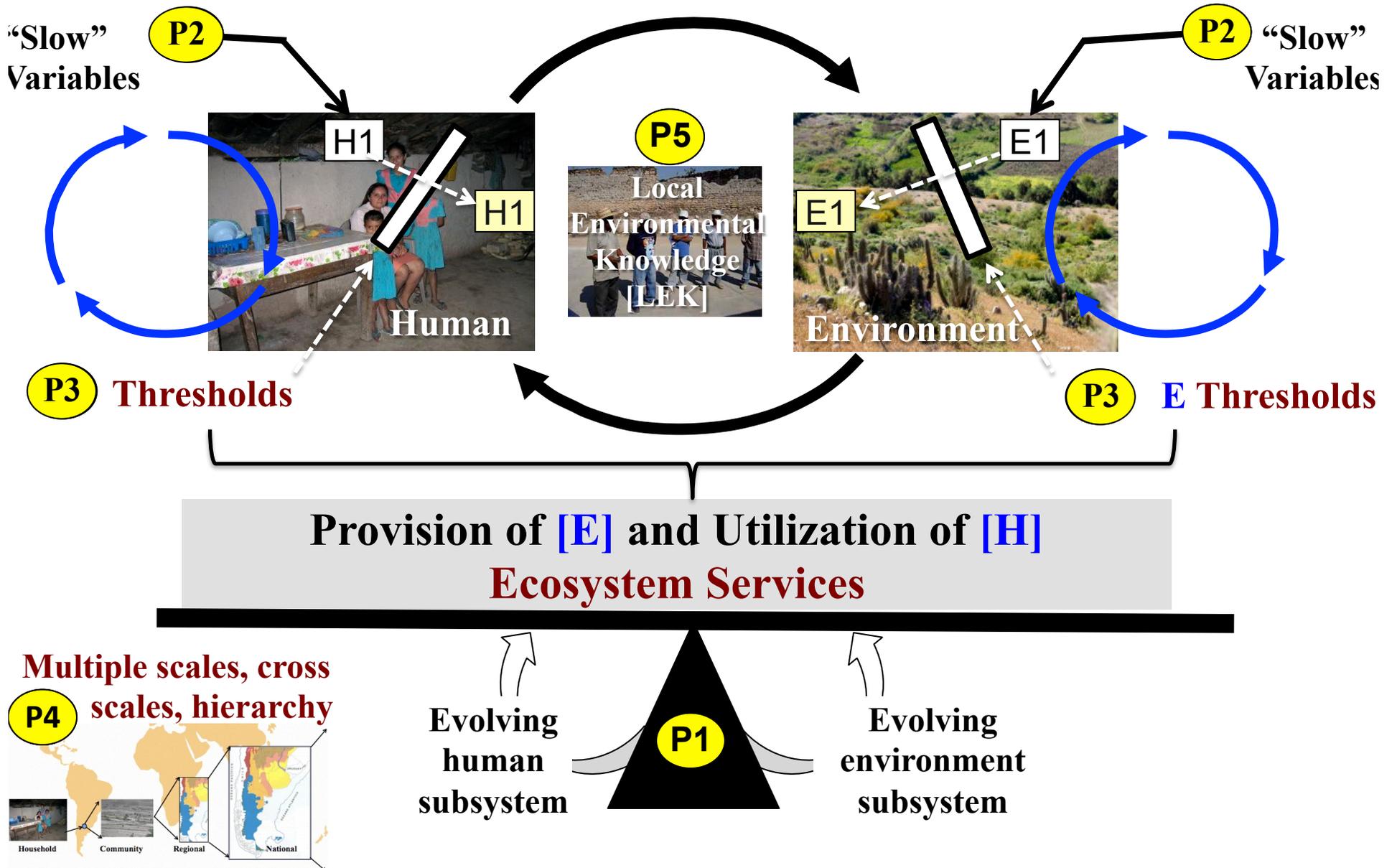
Environmental security



DDP: Principles #2-3: Potential Consequences of Crossing Threshold



Drylands Development Paradigm [DDP]: Principles 1-5



Proximate causes of Land Degradation



Nicholson et al [1998] Bull Amer Met Soc 79(5)

Selling of firewood along roadway in Botswana



Courtesy of Diego Steinaker

Overgrazing-San Luis, Argentina

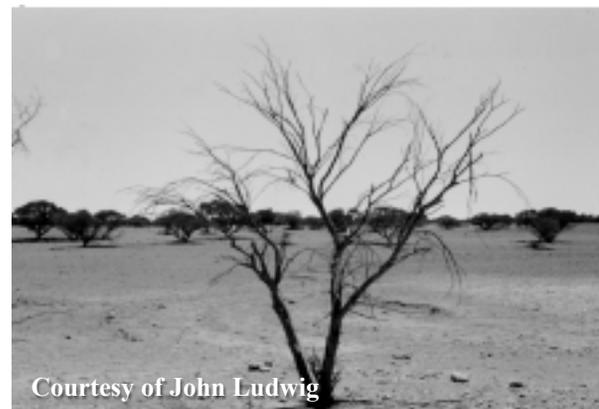


Nicholson et al [1998] Bull Amer Met Soc 79(5)

Agricultural burning in savanna of Botswana



Climate change – drought in China



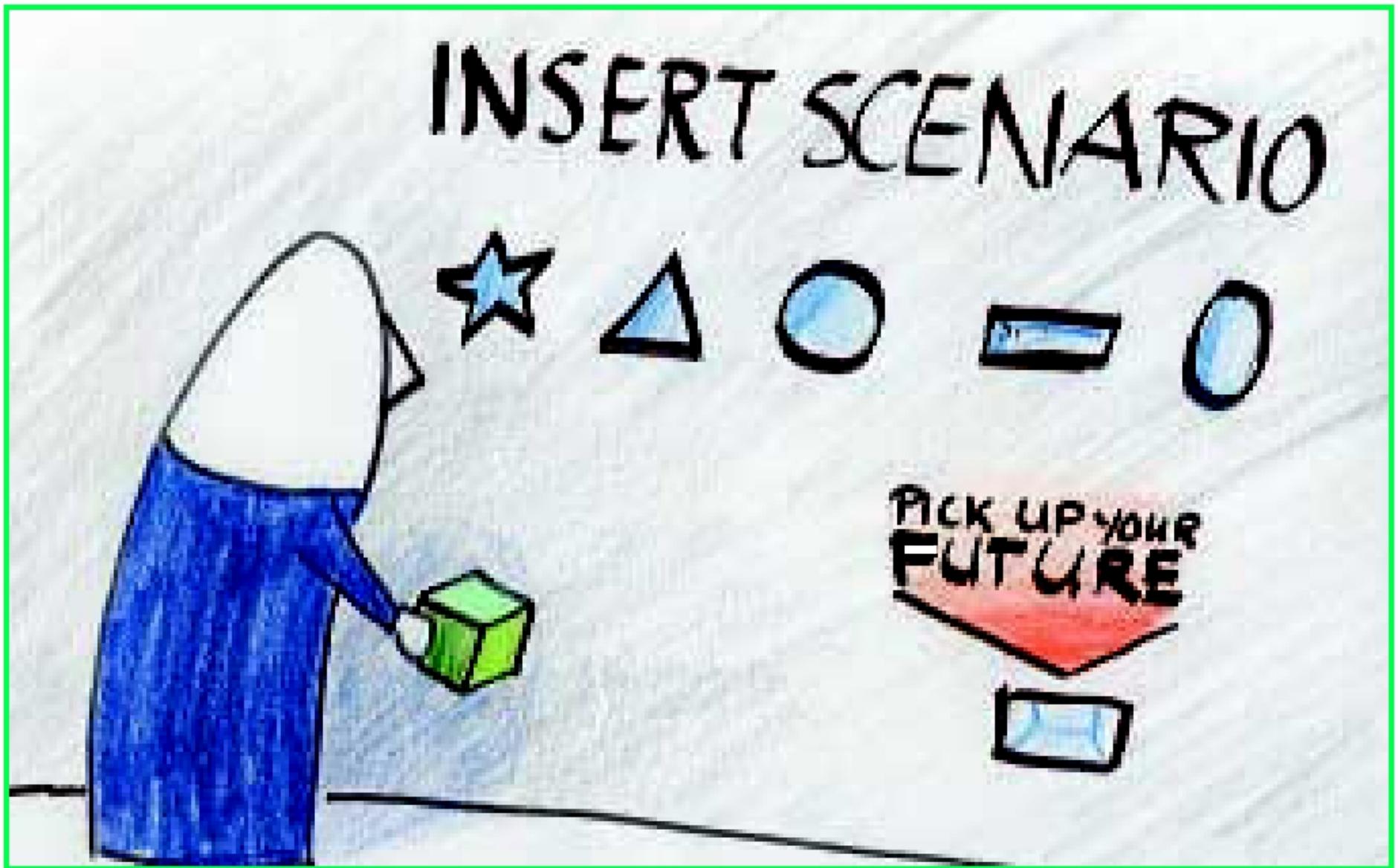
Courtesy of John Ludwig

Loss soil fertility, central Australia, near Alice Springs



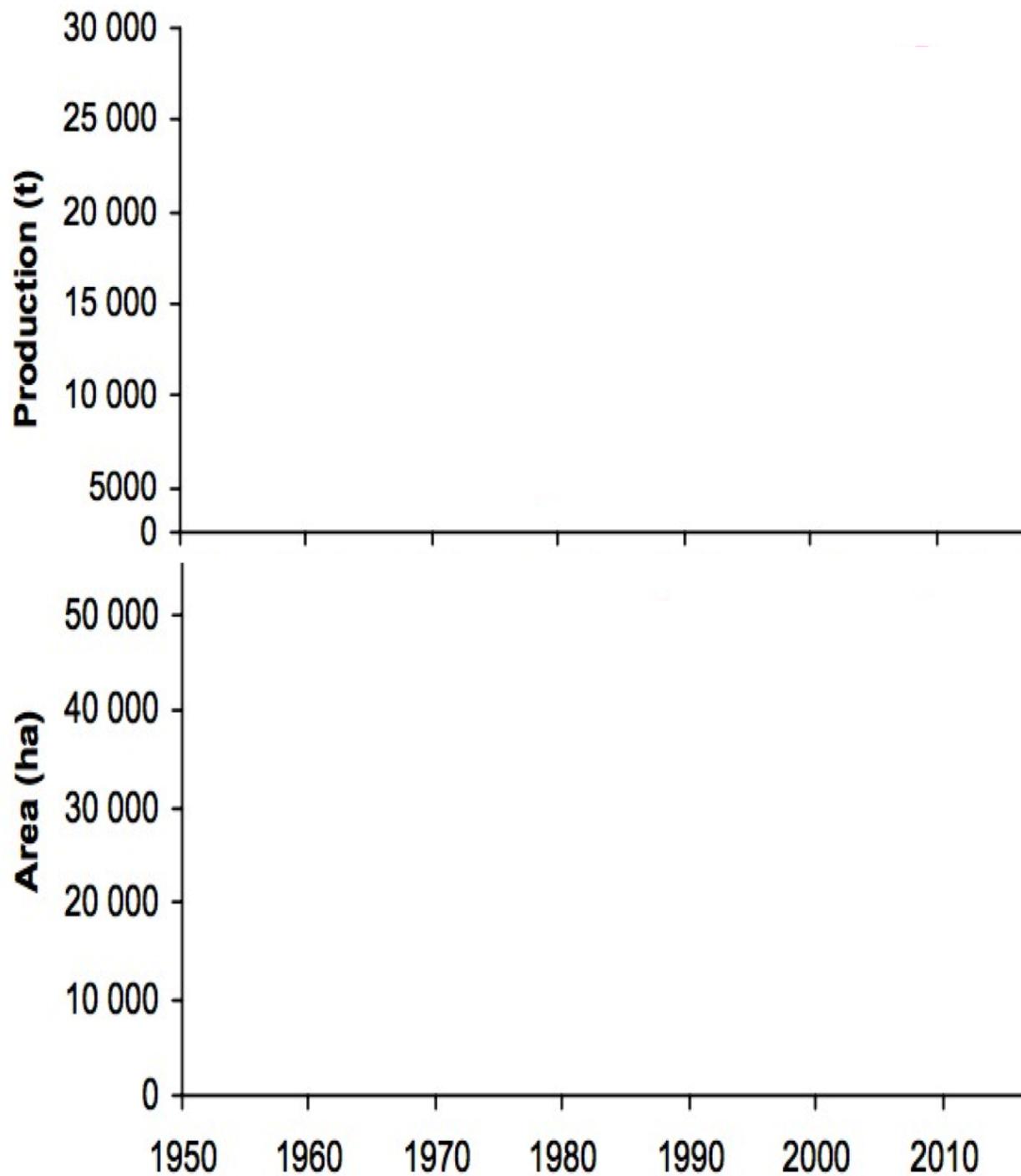
Nicholson et al [1998] Bull Amer Met Soc 79(5)

Overcultivation – millet in W. Africa, near Niamey, Niger



The future can not be predicted





*The “Great Plow-up”
of the Salar de Uni
region of Bolivia*



S-E Jacobsen, *J Ag and Crop Sci* (2011)
doi:10.1111/j.1439-037X.2011.00475.x