Human exposure to Mercury as a consequence of deforestation by slash and burn agriculture in the Amazon

- Marc Lucotte, Robert Davidson, Nicolina Farella & Nicolas Mainville
- Institut des sciences de l'environnement
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- LBA-ECO 9th science meeting, Sao Paulo, Nov. 11, 2005

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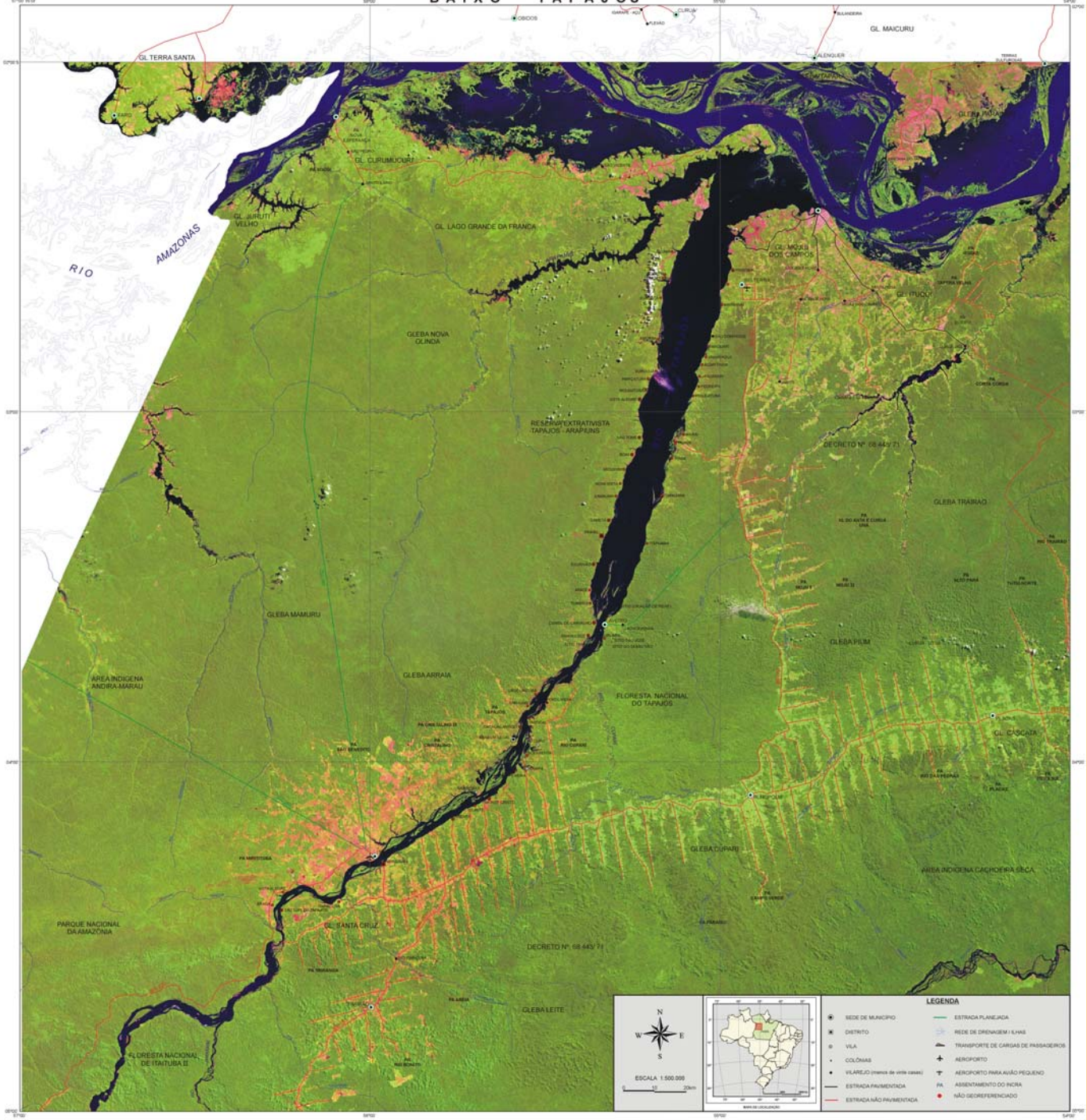
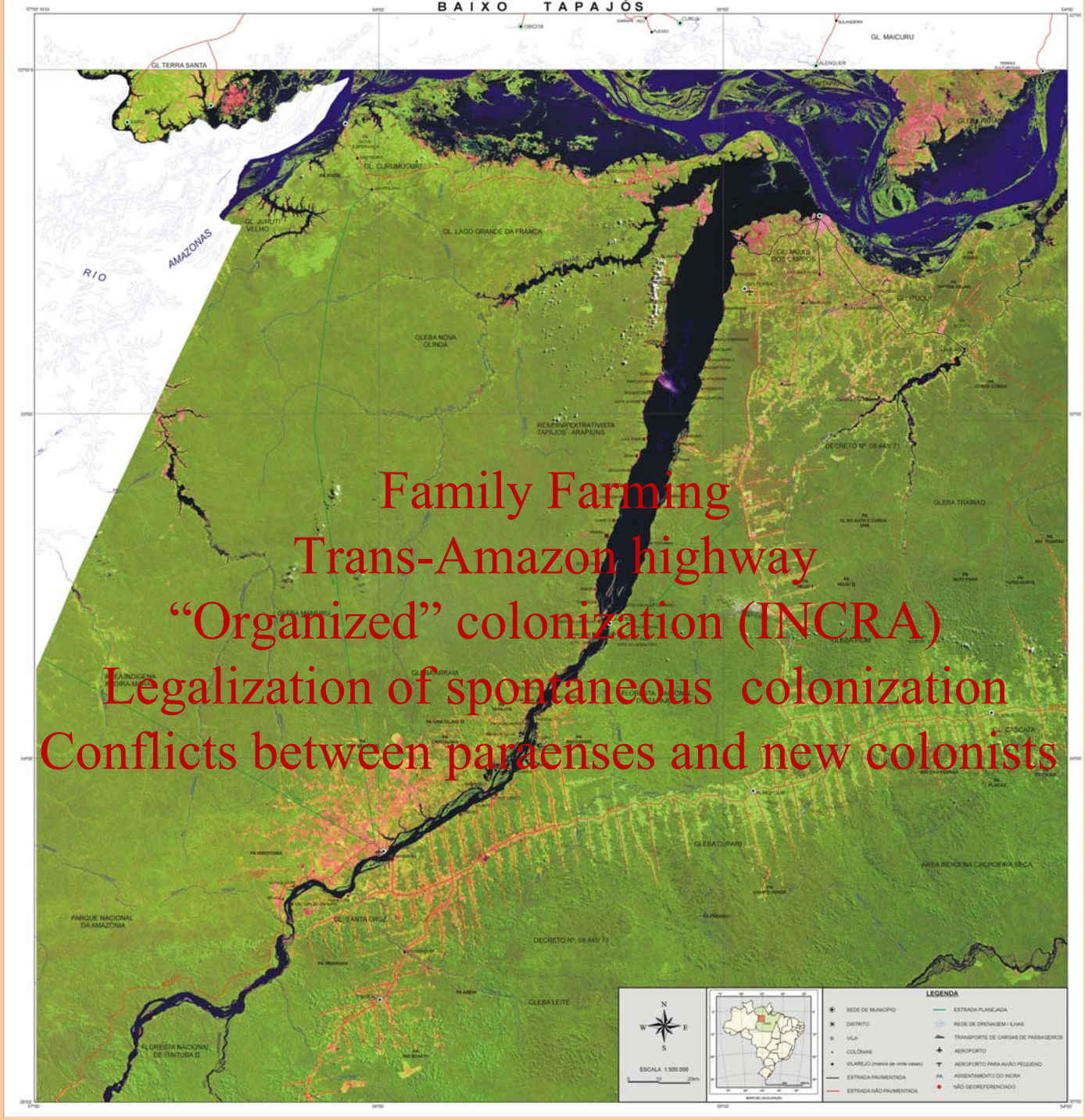
- **Projects mainly funded by IDRC, NSERC and CNPq**

BAIXO TAPAJÓS



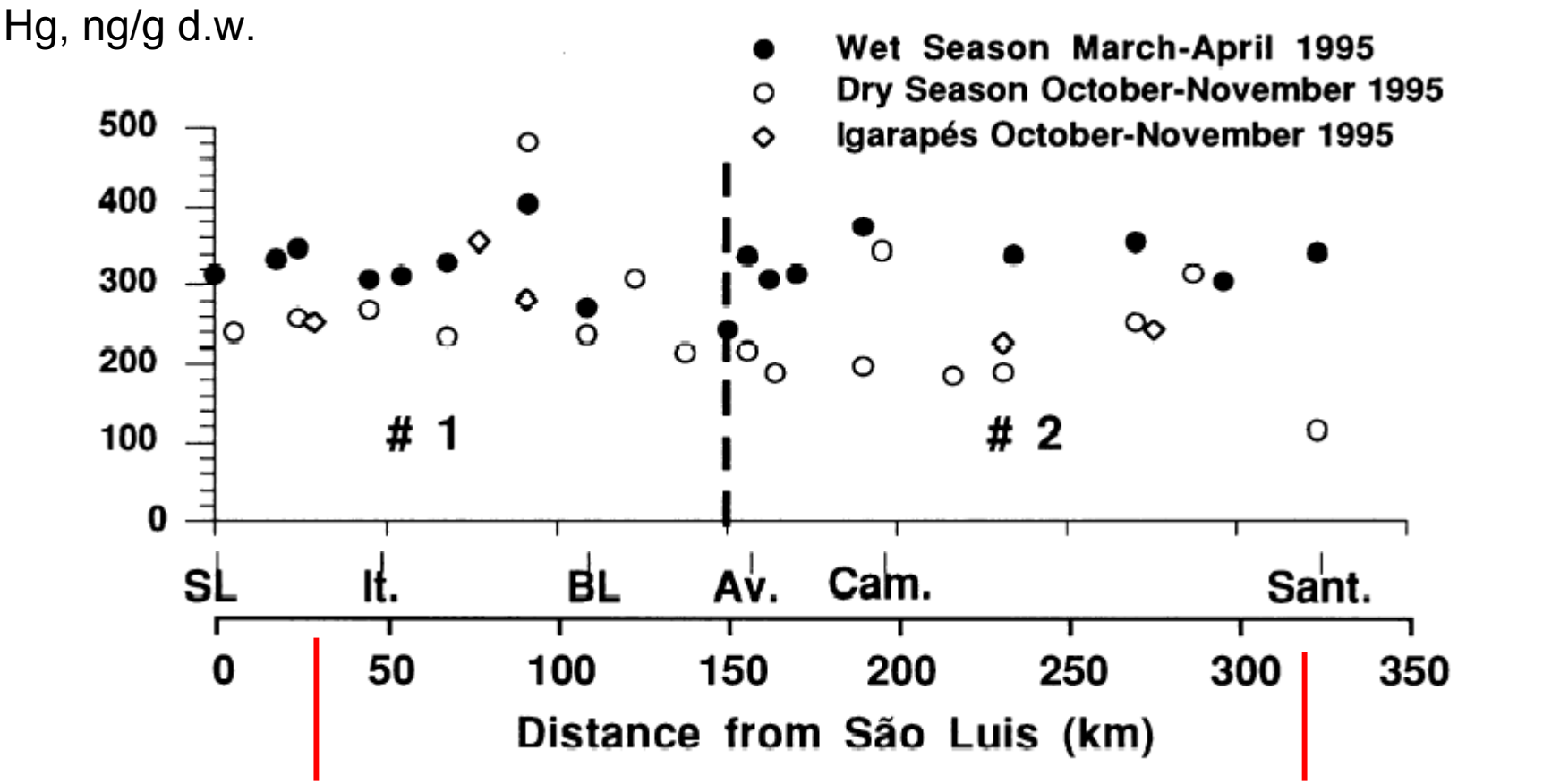


Family Farming
Trans-Amazon highway
"Organized" colonization (INCRA)
Legalization of spontaneous colonization
Conflicts between paraenses and new colonists

Preconceived ideas:

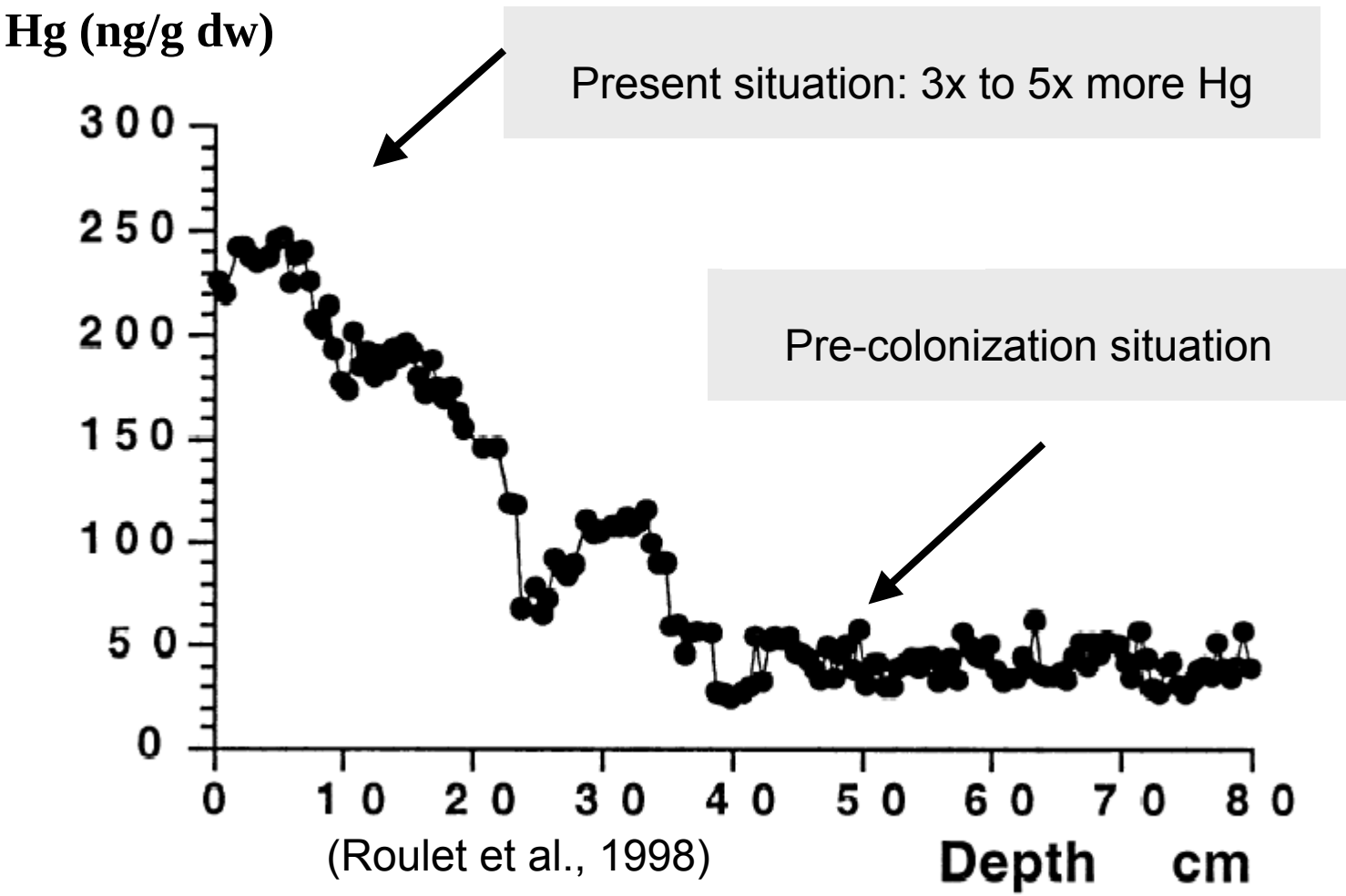
- Presence of mercury attributable to small scale gold mines
- Communities exposed to Hg mostly in regions of gold mines

No decreasing gradient in Hg Conc. in SPM along the Tapajós River away from gold mines



(Roulet et al., 1998)

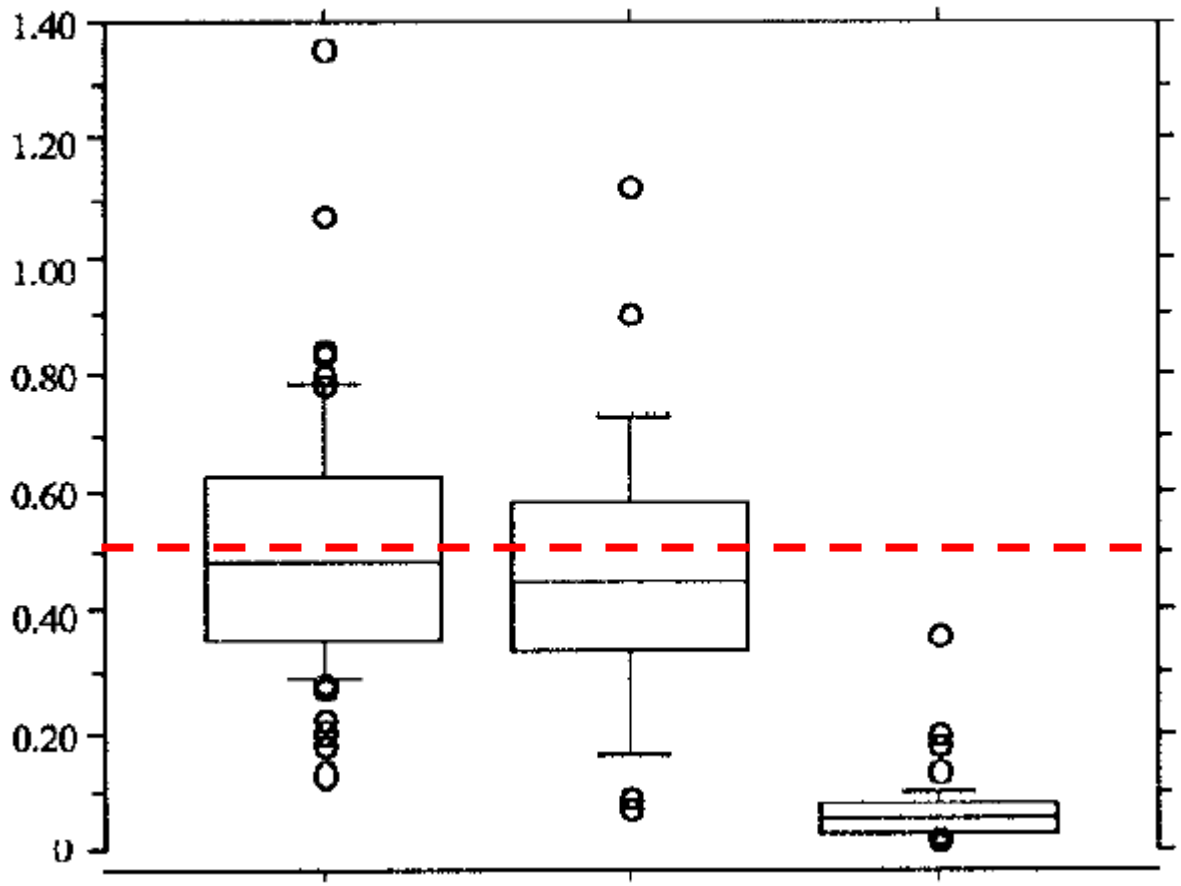
Recent Hg pollution (less than 40 years) as evidenced in lake sediments records



(Roulet et al., 1998)

Half carnivorous fish have Hg concentrations over the recommended limit of 0.5 ppm

Total Hg
µg/g Fresh Weight



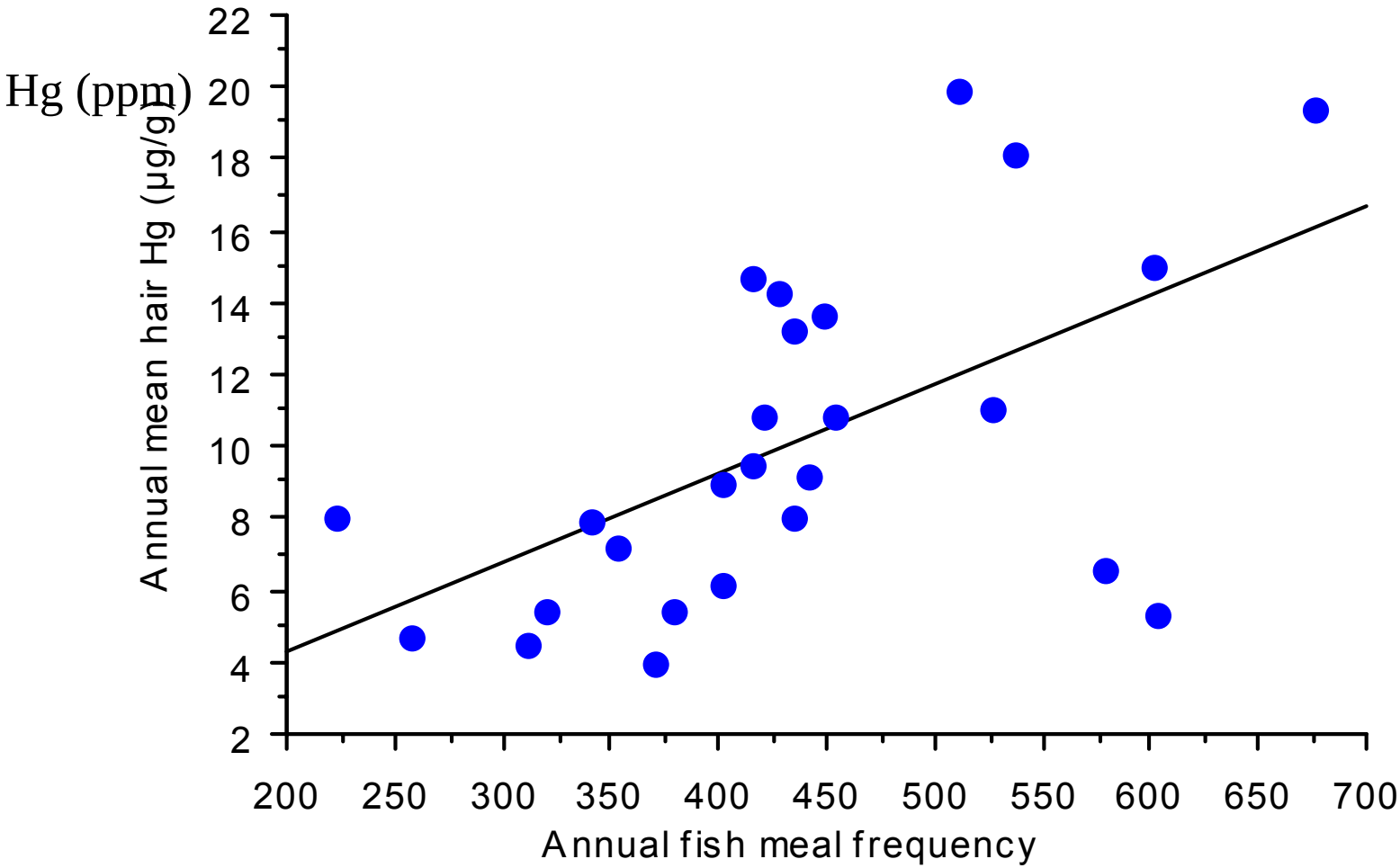
(Lebel et al., 1997)

Piscivorous n=57

Omnivorous n=22

Herbivorous n=53

Relationship between fish consumption and human exposure to Hg as seen by Hg levels in hair



(Passos et al., 2003)

Now, two questions:

- Do the observed Hg levels affect the health of local communities?
- If this Hg does not come from goldmining, what is its origin?

Donna Mergler's famous diagram on Human Health & Mercury

Early alterations of nervous system

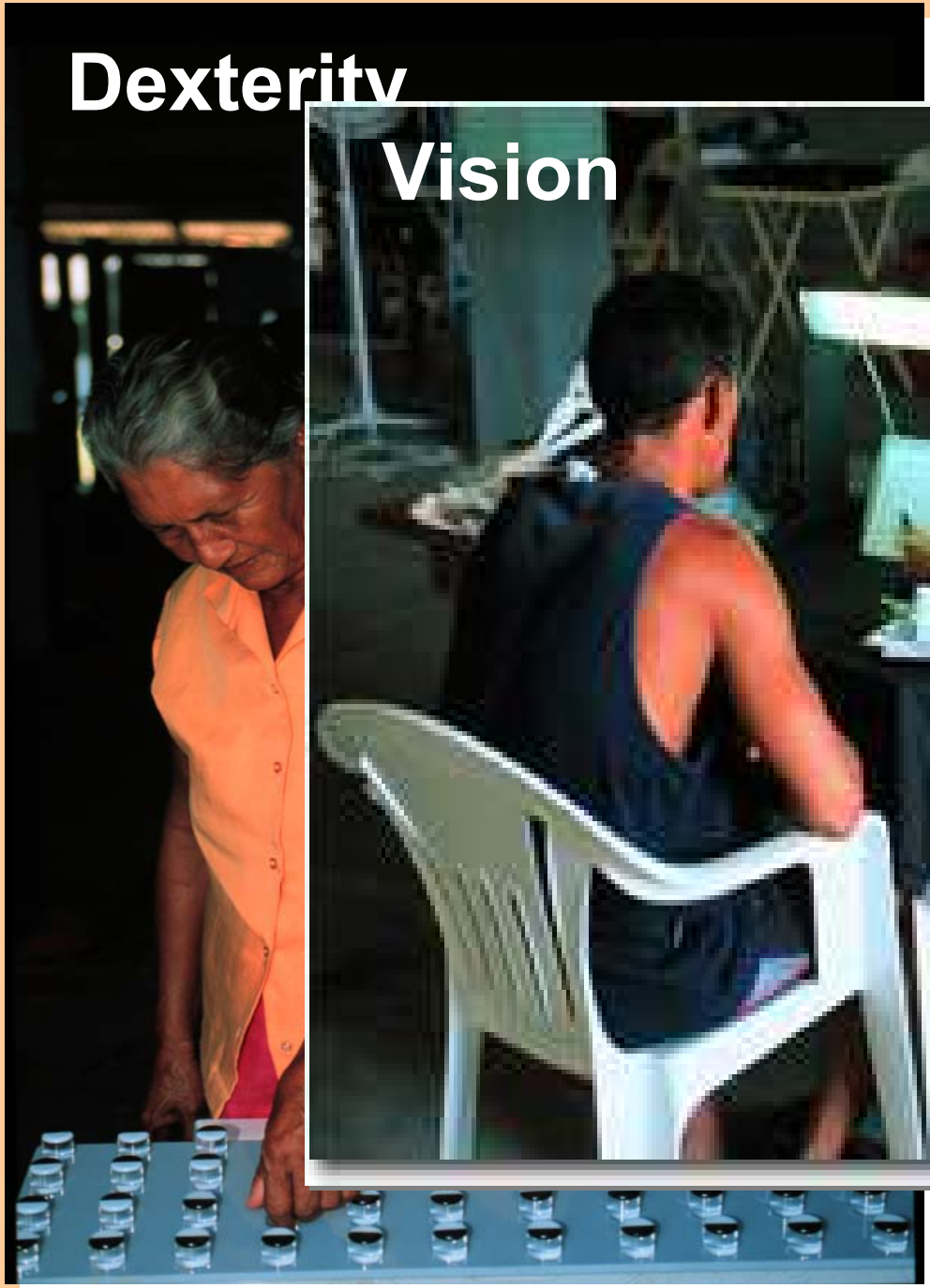
?

Subclinic neurological signs

(50 ppm)

Exposure to mercury

Dexterity



Vision

Other health problems related to chronic exposure to low levels of Hg:

- Cardiovascular problems

(Filion et al., 2005)

- Auto-imune system problems

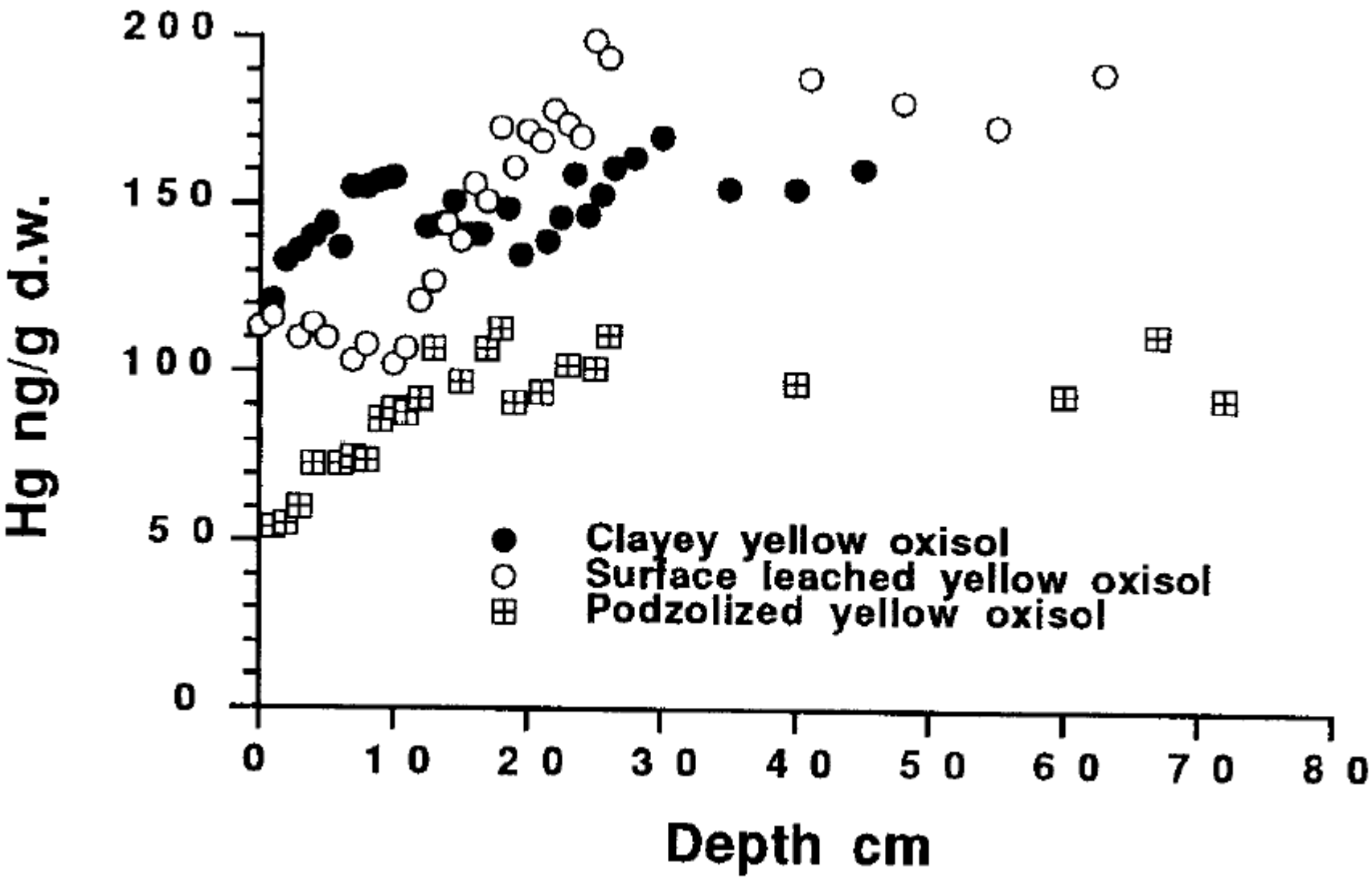
(Silbergeld et al. 2005)

…

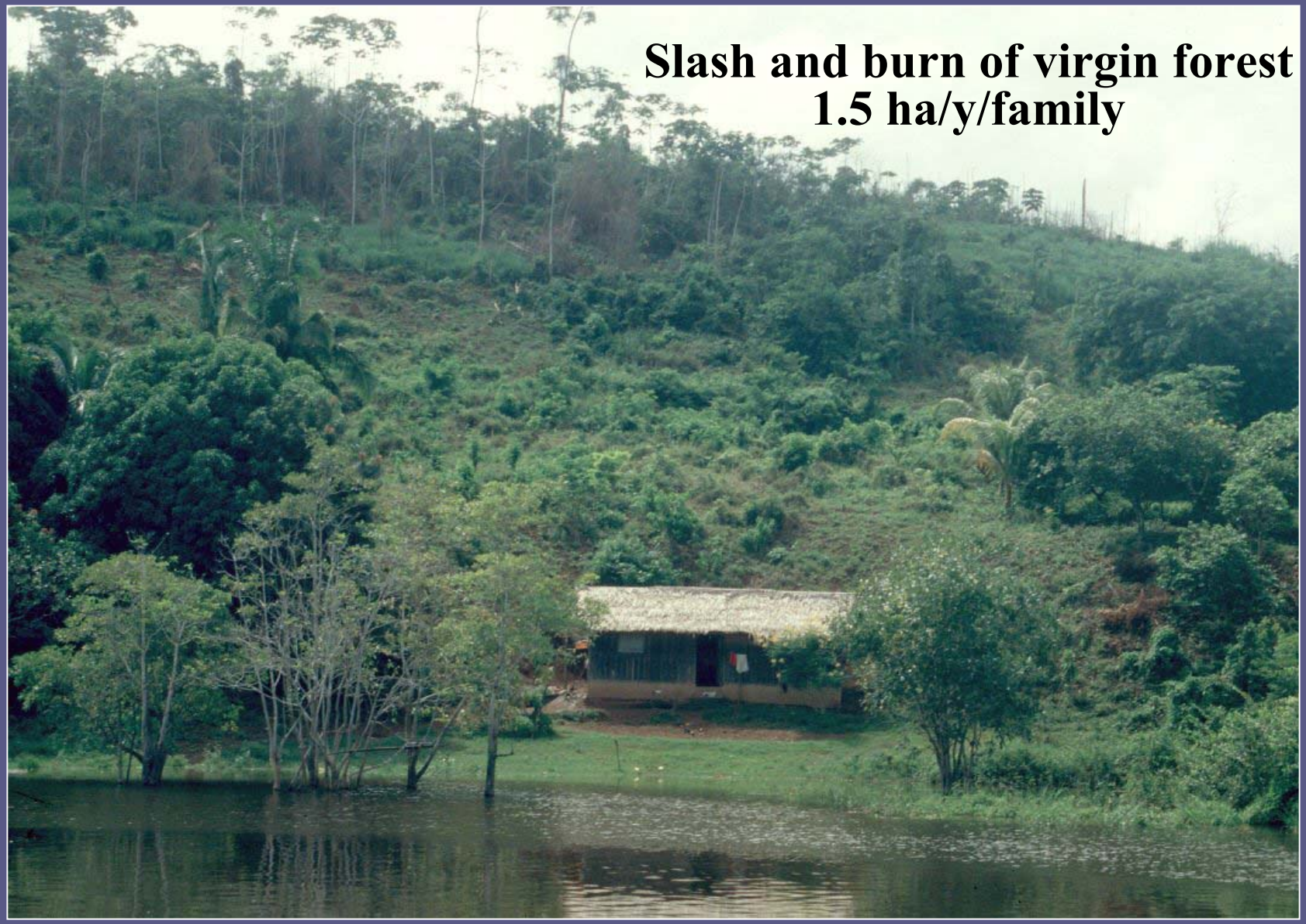
Two questions:

- Do the observed Hg levels affect the health of local communities?
- If this Hg does not come from goldmining, what is its origin?

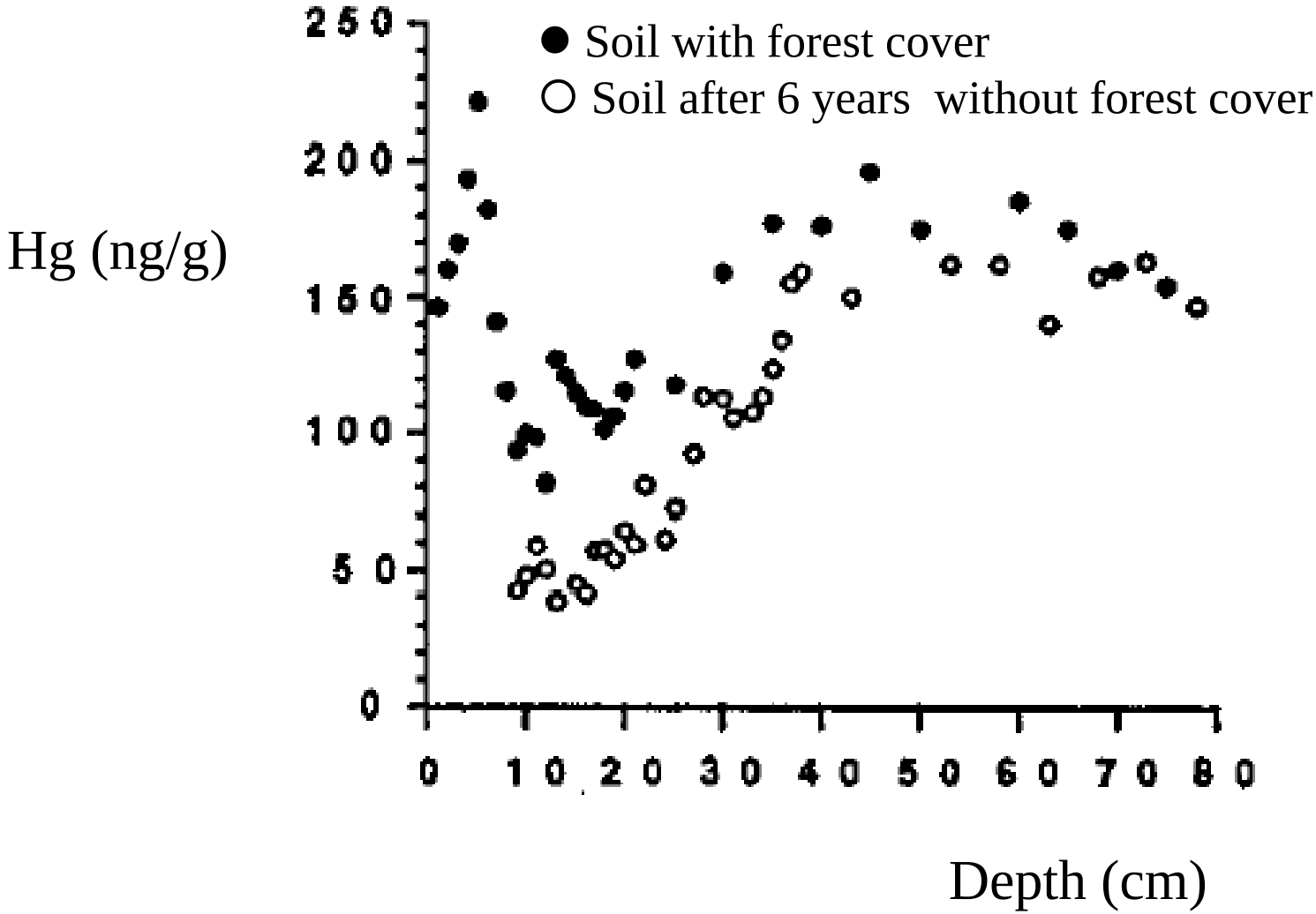
High Hg Concentrations in river bank soils: natural origin (Roulet et al., 1999)



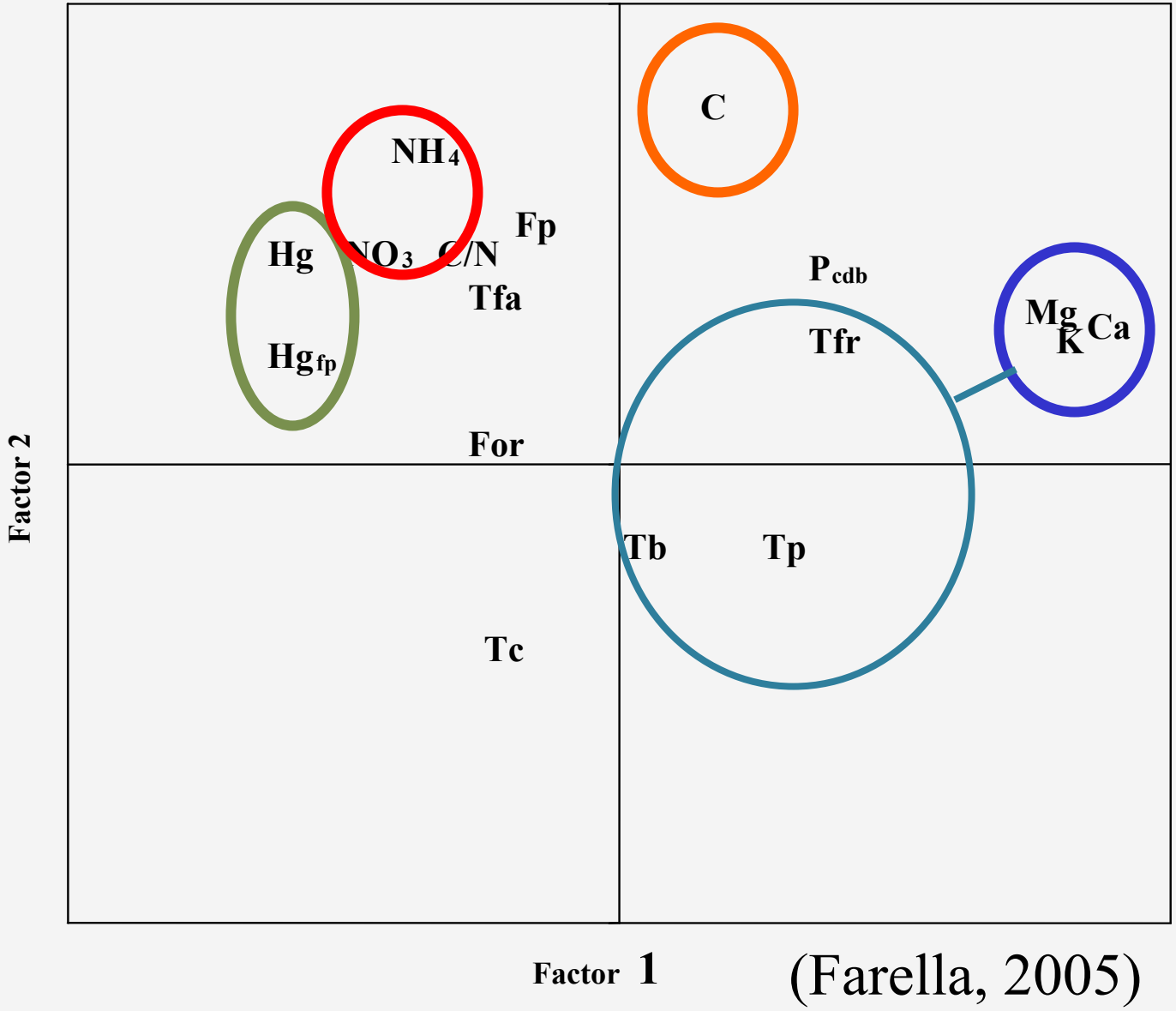
Rapid progression of colonization



Important loss of Hg in soils recently (6 years) deforestated for agriculture (Roulet et al., 1998)

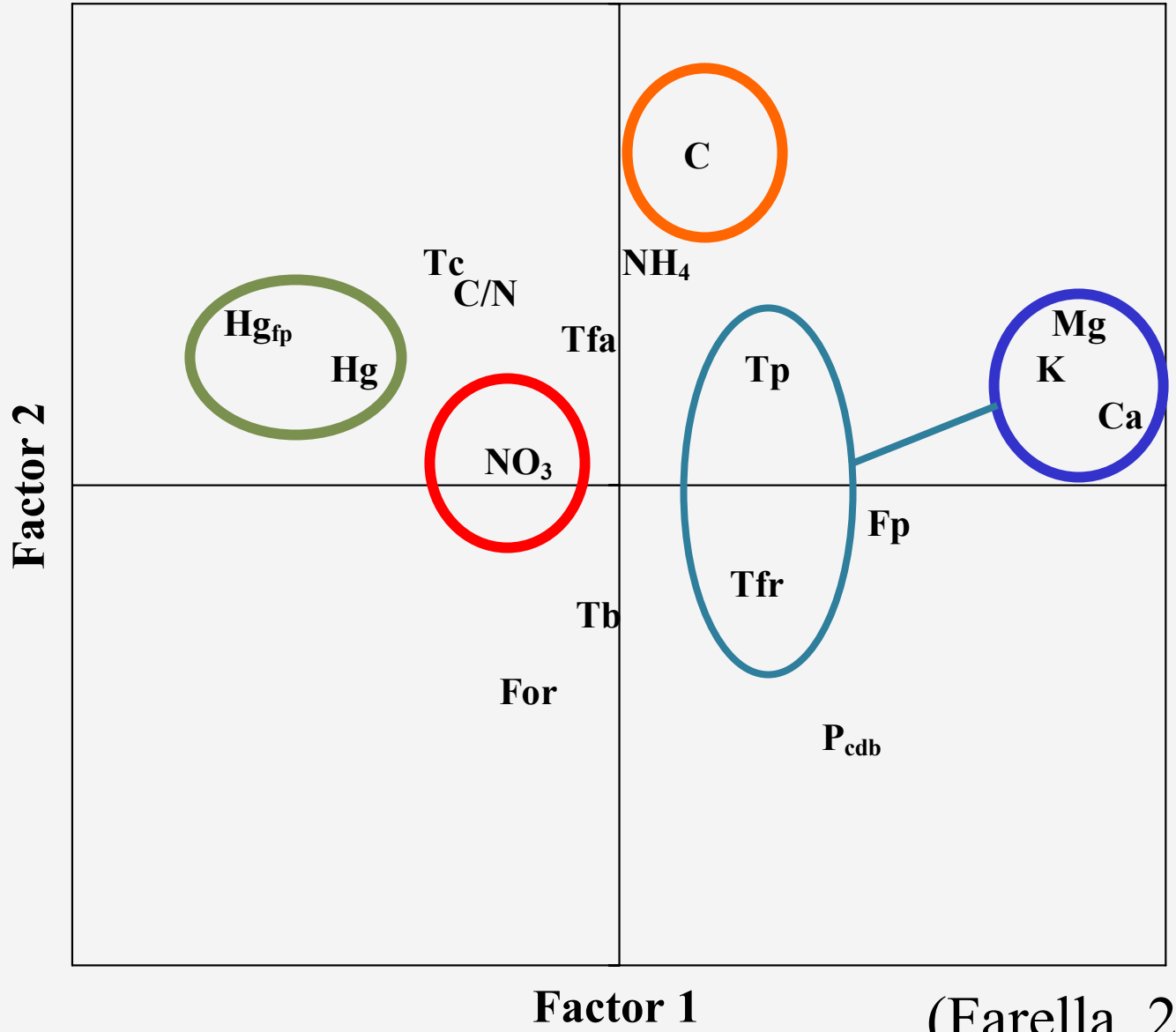


PCA Clay Soils at 25 cm



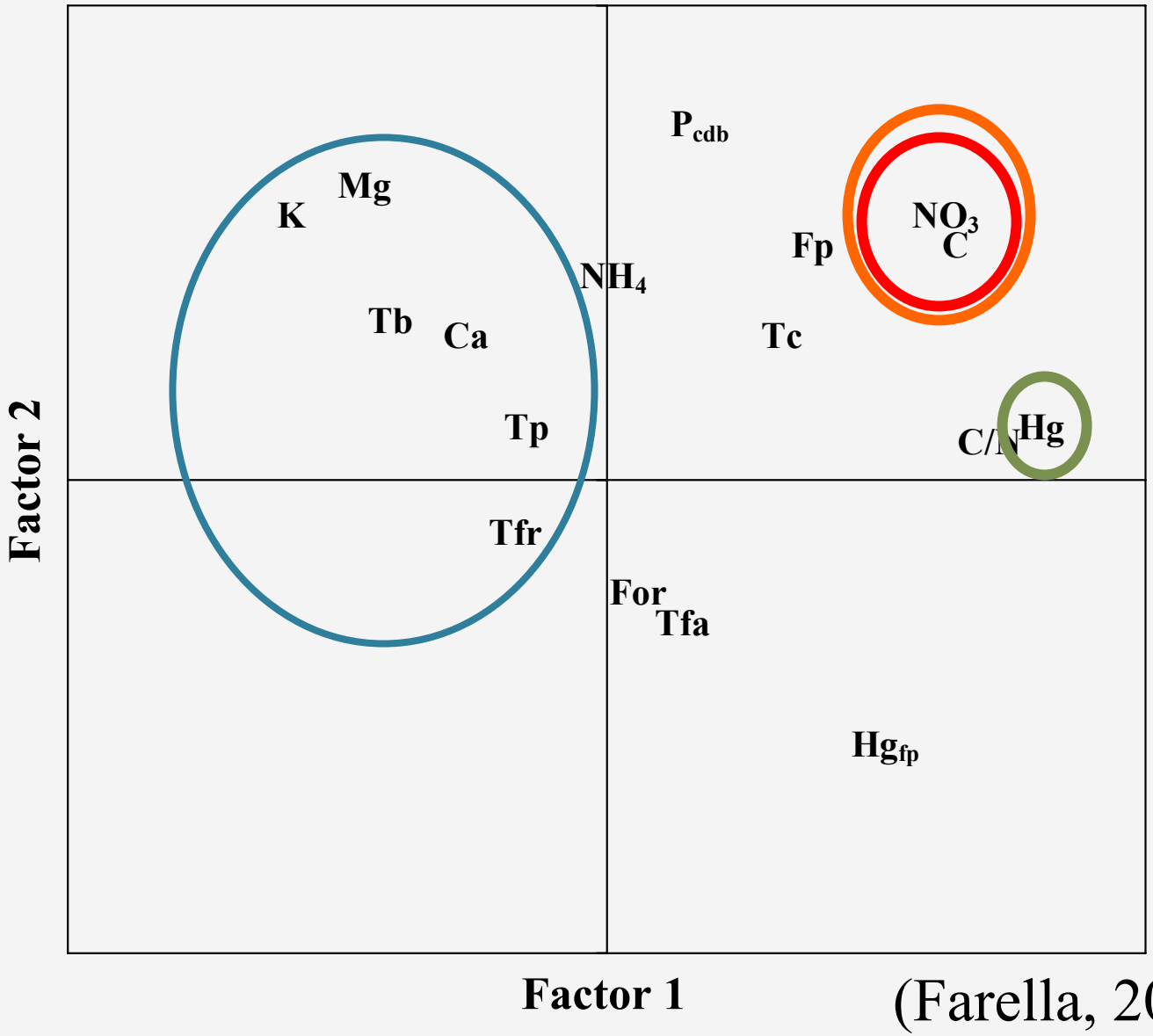
(Farella, 2005)

PCA Clay Soils at 50 cm



(Farella, 2005)

PCA Sandy-clay Soils at 25 cm

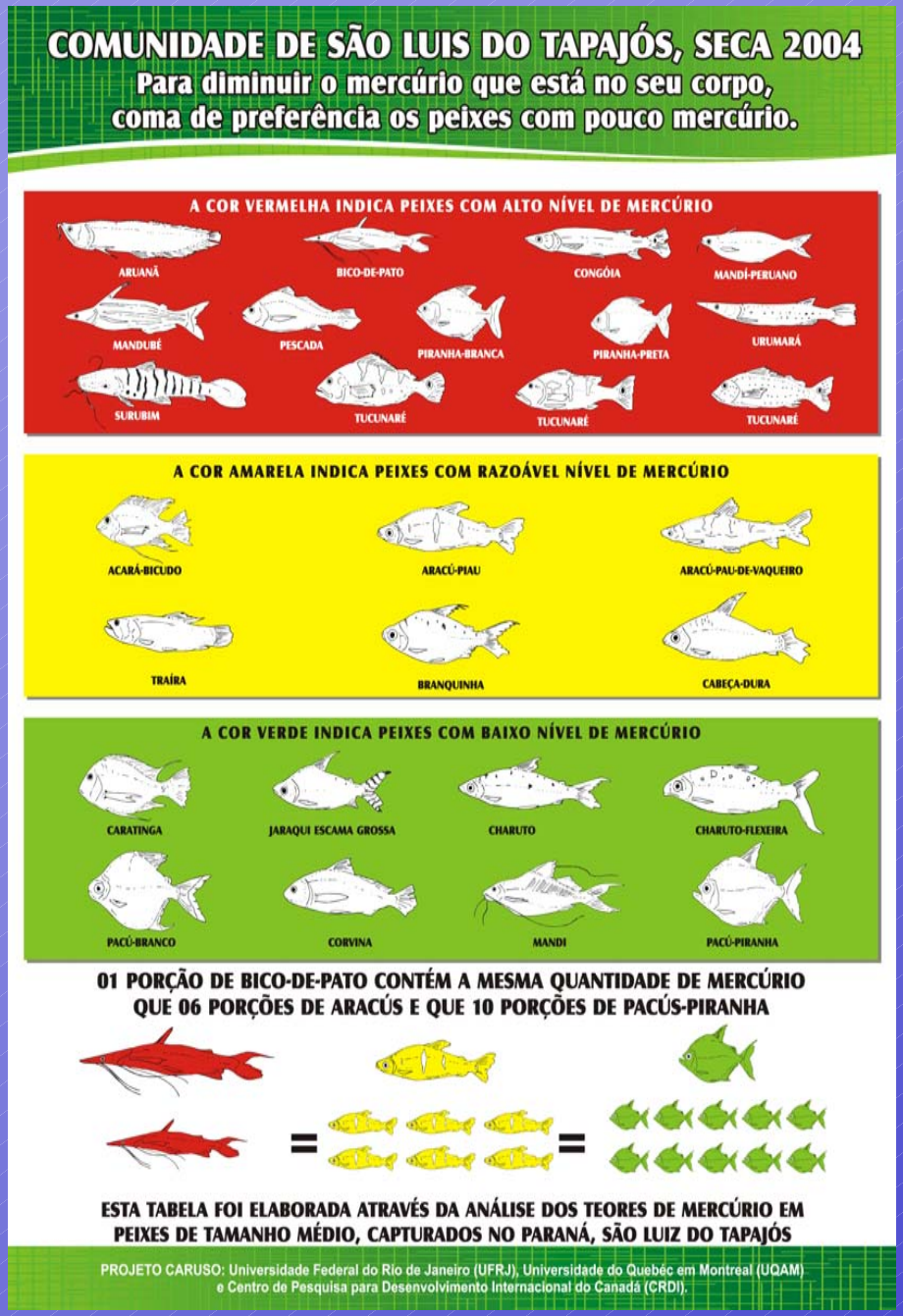


(Farella, 2005)

Any solutions to the problem?

- Short term: limit exposure
- Long term: limit deforestation of sensitive areas

Participatory research:



Red: high mercury levels

Yellow: moderate mercury levels

Green: low mercury levels

http://www.unites.uqam.ca/gmf/caruso.htm

Fish consumption (1995-2000)

(n = 47) (Mergler et al., 2005)

	1995	2000
	123 meals per week	122 meals per week
Carnivorous	59 (48%)	21 (18%)
Herbivorous	20 (16%)	64 (52%)

Hair Hg levels (1995-2000)

(n = 47) (Mergler et al., 2005)

1995	2000	reduction
17.9 µg/g	10.9 µg/g***	39.1%

*** $p < 0.001$

Any solutions to the problem?

- Short term: limit exposure
- Long term: Reconcile Fishing and farming by developping sustainable regional agroforestry

Developping sustainable regional agroforestry

- Understand social background of communities

Pará
North-East
Venezuela
Colombia
Guyana
Suriname
French Guiana
Peru
Bolivia
Paraguay
Argentina
Chile
Uruguay
Pacific Ocean
Atlantic Ocean
Georgetown
Paramaribo
Cayenne
Santa Elena
Boa Vista
Macapá
Belém
São Luís
Manaus
Santarém
Careiro
Itaituba
Santa Inês
Fortaleza
Teresina
Benjamin Constant
JacareAcanga
Pôrto Franco
Natal
Picos
João Pessoa
Humaitá
Porto Velho
Recife
Cachimbo
Maceió
Juázeiro
Rio Branco
Aracaju
Gurupi
Barreiras
Vilhena
Ibotirama
Salvador
Urabamba
Cuzco
Vitória de Conquista
Brasilia
Cuiabá
Puno
La Paz
Goiânia
Arequipa
Mollendo
Pirapora
Montes Claros
Porto Seguro
Santa Cruz
Arica
Sucre
Uberlândia
Iquique
Uyuni
Belo Horizonte
Campo Grande
Vitória
Dourados
Volta Redonda
Niterói
Rio de Janeiro
São Paulo
Antofagasta
Santos
Asunción
Foz do Iguaçu
Curitiba
San Miguel de Tucumán
São Borja
Florianópolis
Porto Alegre
Osório
La Serena
Pelotas
Santa Fe
Córdoba
Paysandú
Rosario
Mendoza
Valparaíso
Santiago
Buenos Aires
Montevideo
Amazon
Tocantins
Araguaia
Xingu
72°W
60°
48°
36°
0°
12°S
24°
1992 MAGELLAN GeographixSMSanta Barbara, CA (800) 929-4627

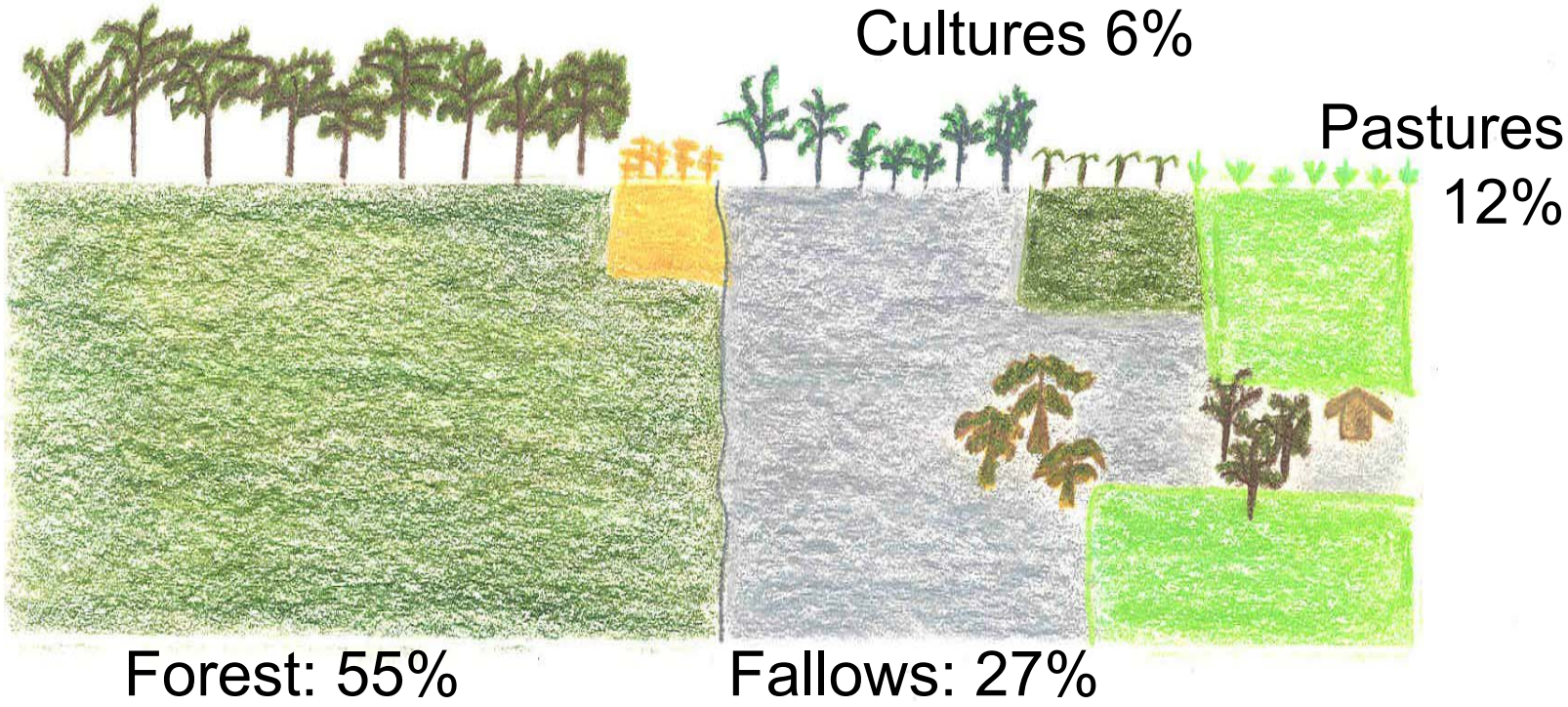
Activities on family lots in relation to origin

		PA	NE
Bananas	kg/y	14,600	22,700
Rice	kg/y	700	1,900
Cattle	beef	7.9	12.5
Fishing	kg/week	16	8
Hunting	%	64	55

Developping sustainable regional agroforestry

- Understand social background
- Understand usual farming practices

After 19 years of land colonization



Average lot size of 70 ha (350 m x 2 km)

Forest

Culture

Fallow

Culture

Fallow

Culture

Fallow

Culture

Pasture

The number of sequences (culture - fallow) varies a lot among farmers.
The sequence always begins with culture and ends with pasture.

Forest

Culture

Pasture

40% farmers prefer
Only one sequence

Developping sustainable regional agroforestry

- Understand social background
- Understand usual practices
- Elaborate adapted agroforestry models

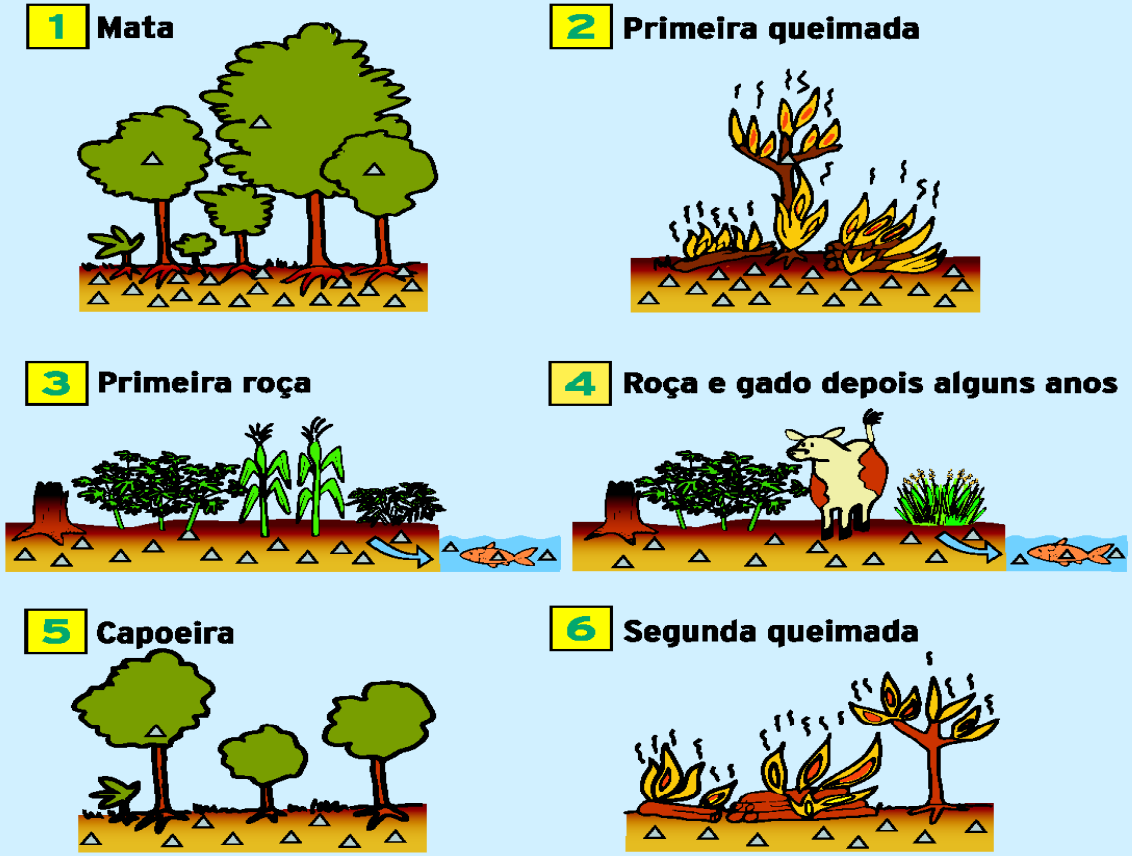
Developping sustainable regional agroforestry

- Understand social background
- Understand usual practices
- Elaborate agroforestry models
- Divulgate through adapted environmental education

E N V I R O N M E N T A L

E D U C A T I O N

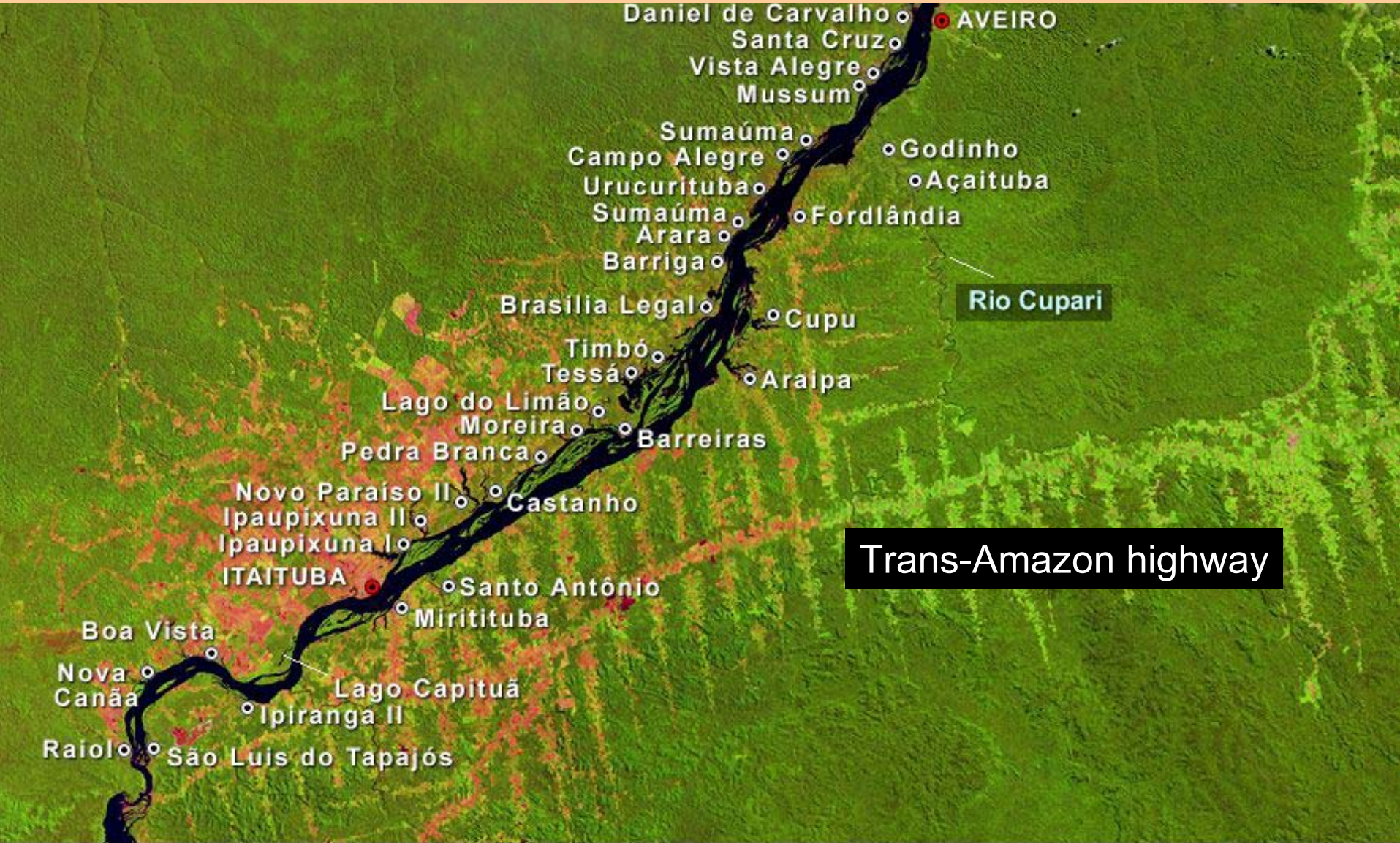
SEQÜÊNCIA DOS CULTIVOS E MERCURIO



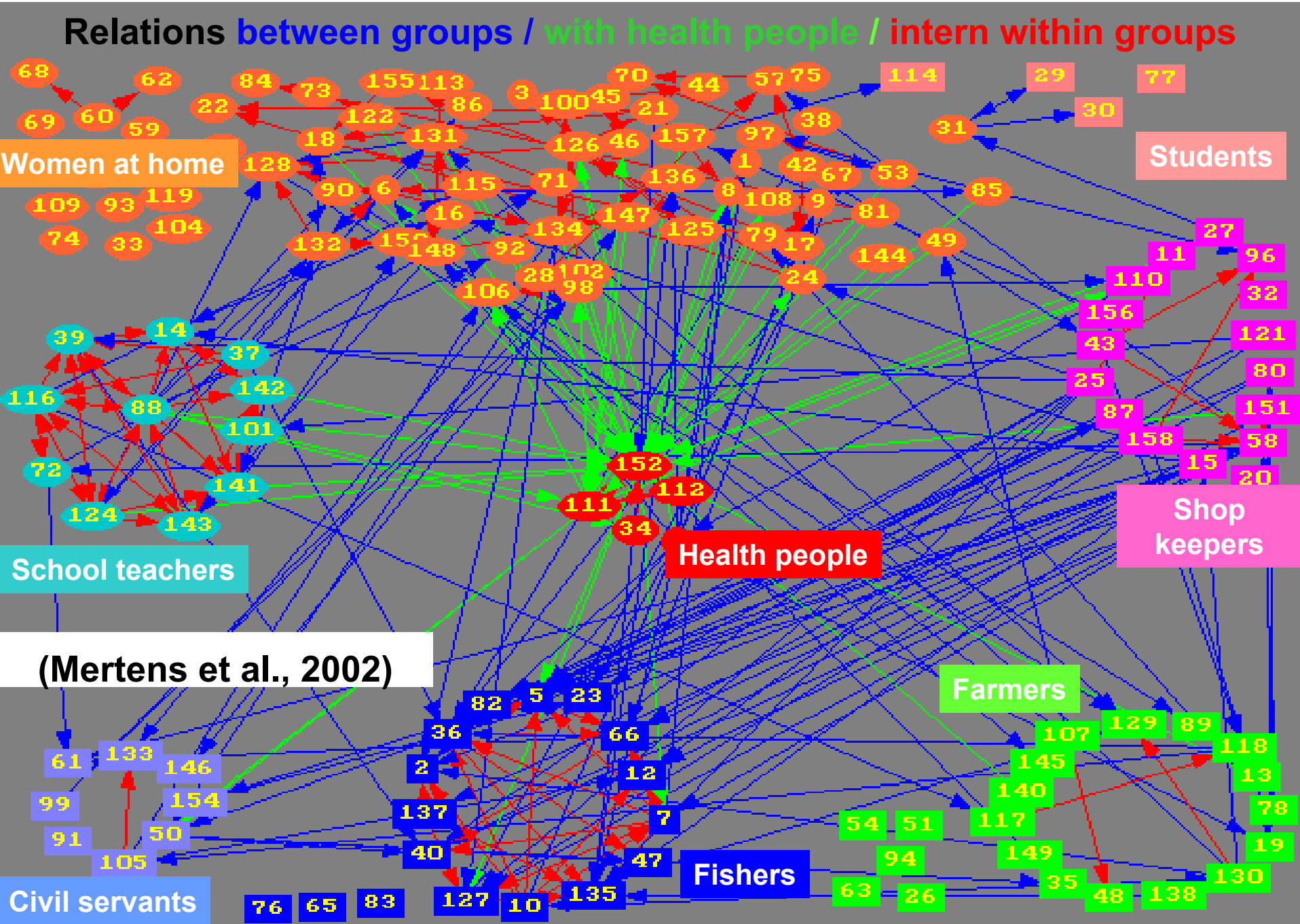
BIODÔME DE MONTRÉAL

Institut des sciences de l'environnement
Université du Québec à Montréal

Regionalization of the project: multiple workshops including representatives of communities, NGO's, local and national governmental institutions



Information web about mercury between inhabitants of Brasília Legal



(Mertens et al., 2002)

Sustainable regional agroforestry practices

Ribeirinhos will not change their behaviors for the sake of the Carbon cycle, neither for fears of climate changes nor biodiversity loss.

But, they will act for a better quality of life, a better health of their family!

Sustainable regional agroforestry practices

Ribeirinhos will not change their behaviors for the sake of the Carbon cycle, neither for fears of climate changes nor biodiversity loss.

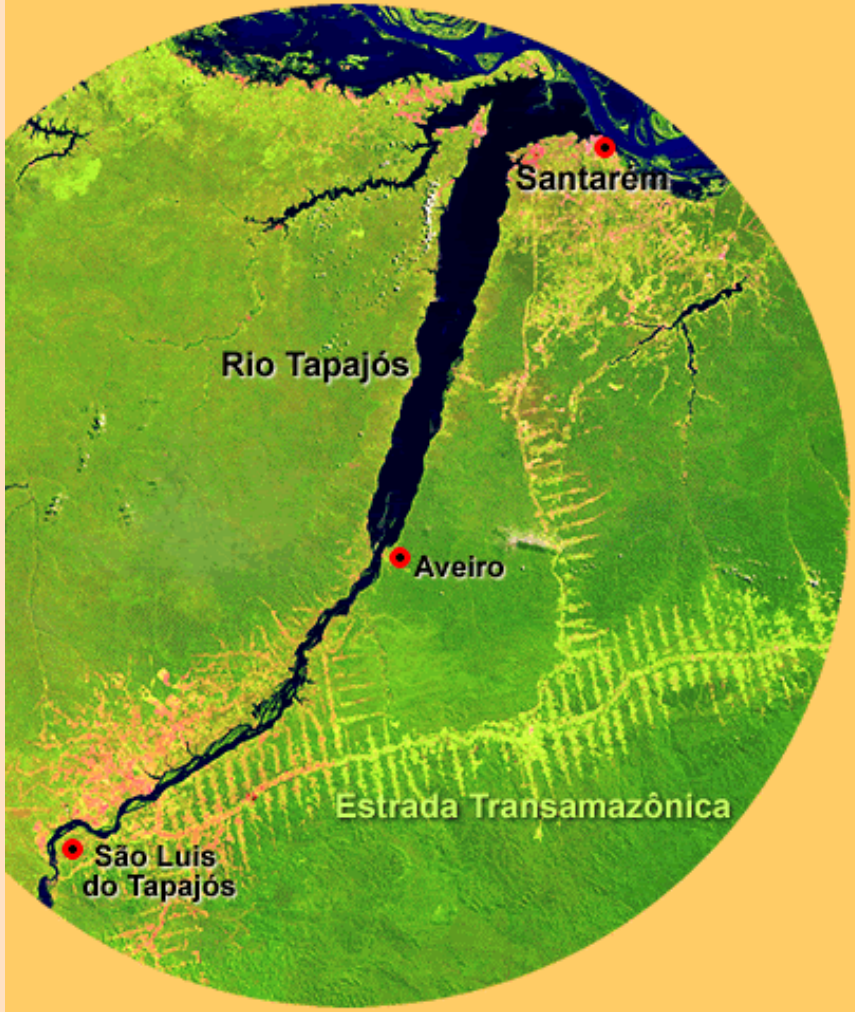
But, they will act for a better quality of life, a better health of their family!

In that sense, Hg lixiviation from newly deforestated soils is a good pretext to change their practices!

Obrigado!

http://www.unites.uqam.ca/saam

SAAM - Sistemas Agrícolas Amazônicos



Contaminação mercurial dos ecossistemas aquáticos do Rio Tapajós na região amazônica:

Uma alavanca para a implementação de modelos agrícolas ribeirinhos baseados no Desenvolvimento sustentável

Objetivos
Área de estudo
Instituições e membros
Links
Notícias
Intranet

Uma proposta de
networking - pesquisa - intervenção

Banco Mundial	INCRA
Biodôme de Montréal	MPEG
CIAT	PSA
EMBRAPA	SUDAM
FCAP	UFPA
IEC	UFRJ
IBAMA	UQAM

Ecosystem representation of Agroforestry practices

Agricultural practices

Cultivated crops

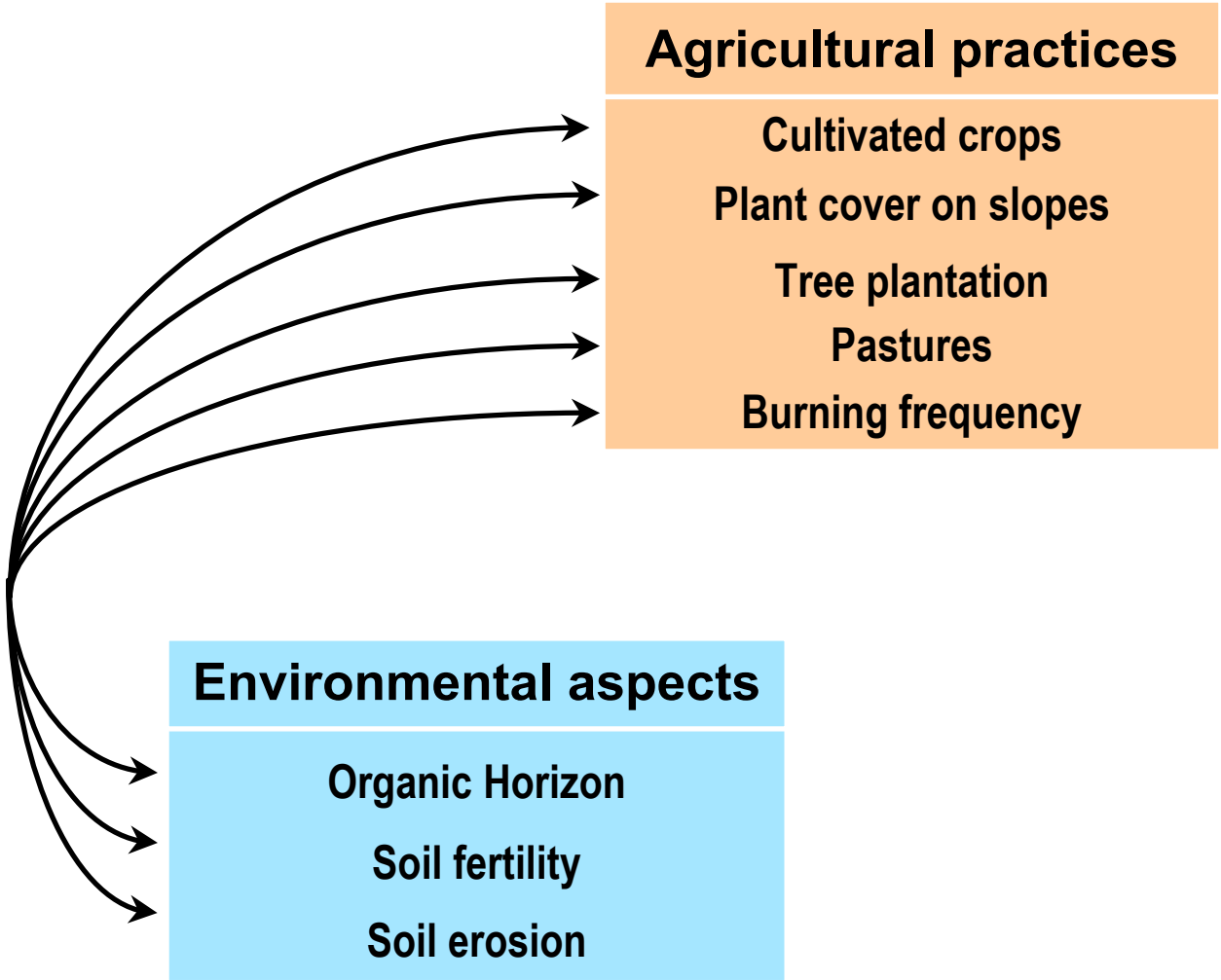
Plant cover on slopes

Tree plantation

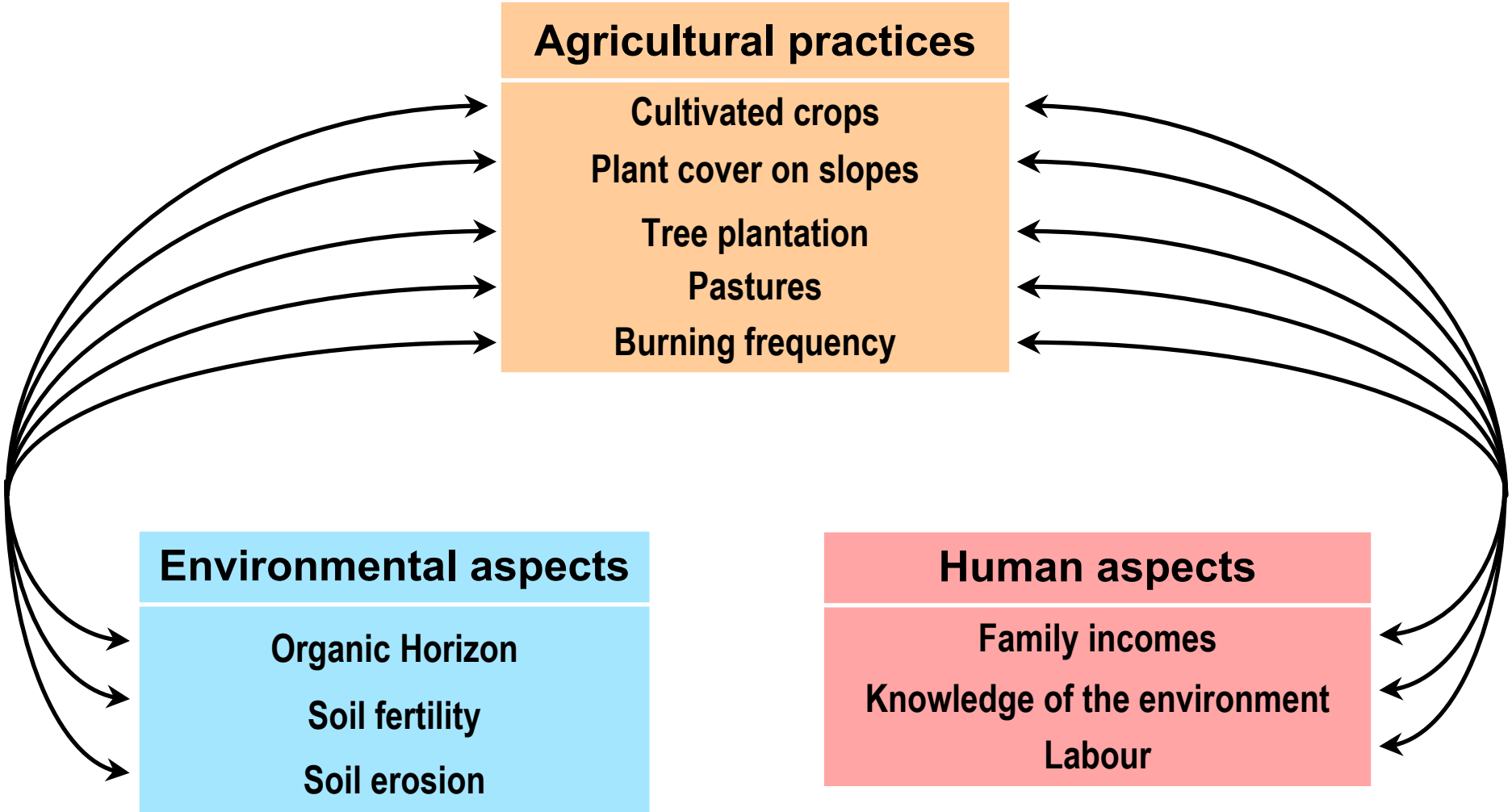
Pastures

Burning frequency

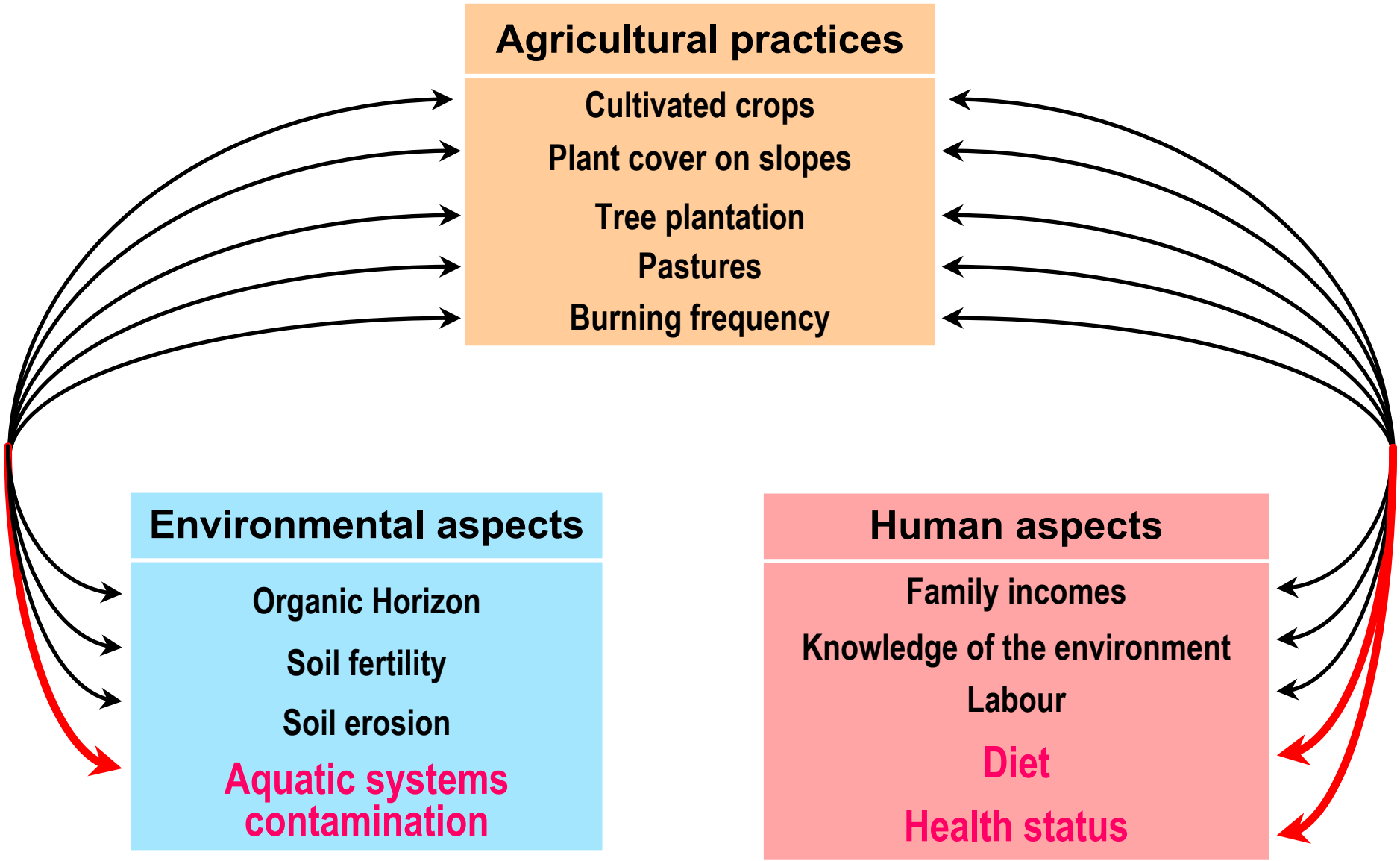
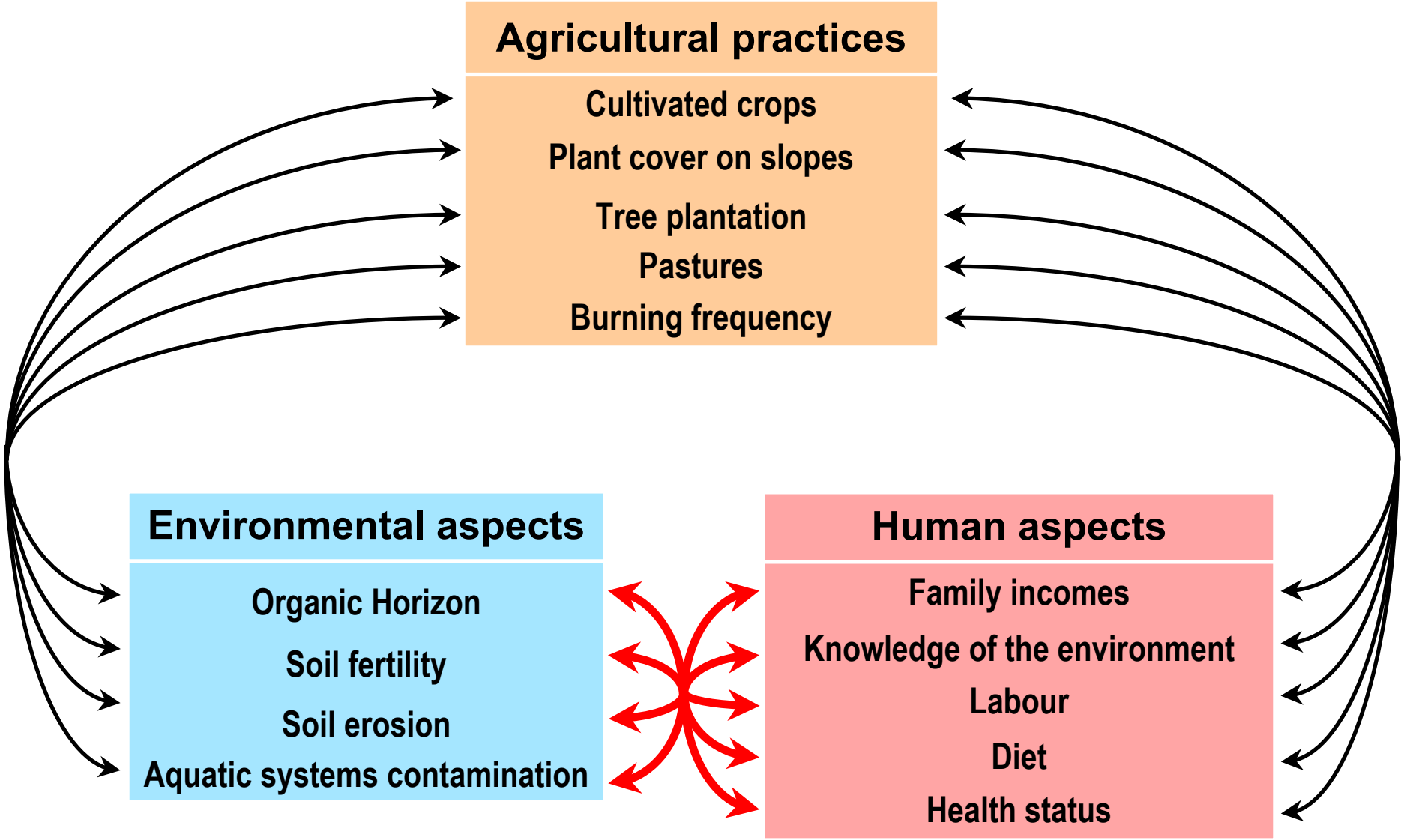
Ecosystem representation of Agroforestry practices



Ecosystem representation of Agroforestry practices



Ecosystem representation of Agroforestry practices



Ecosystem representation of Agroforestry practices