Foreste e Cambiamenti Climatici

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Consiglio Nazionale delle Ricerche/Food and Agricolture Organization
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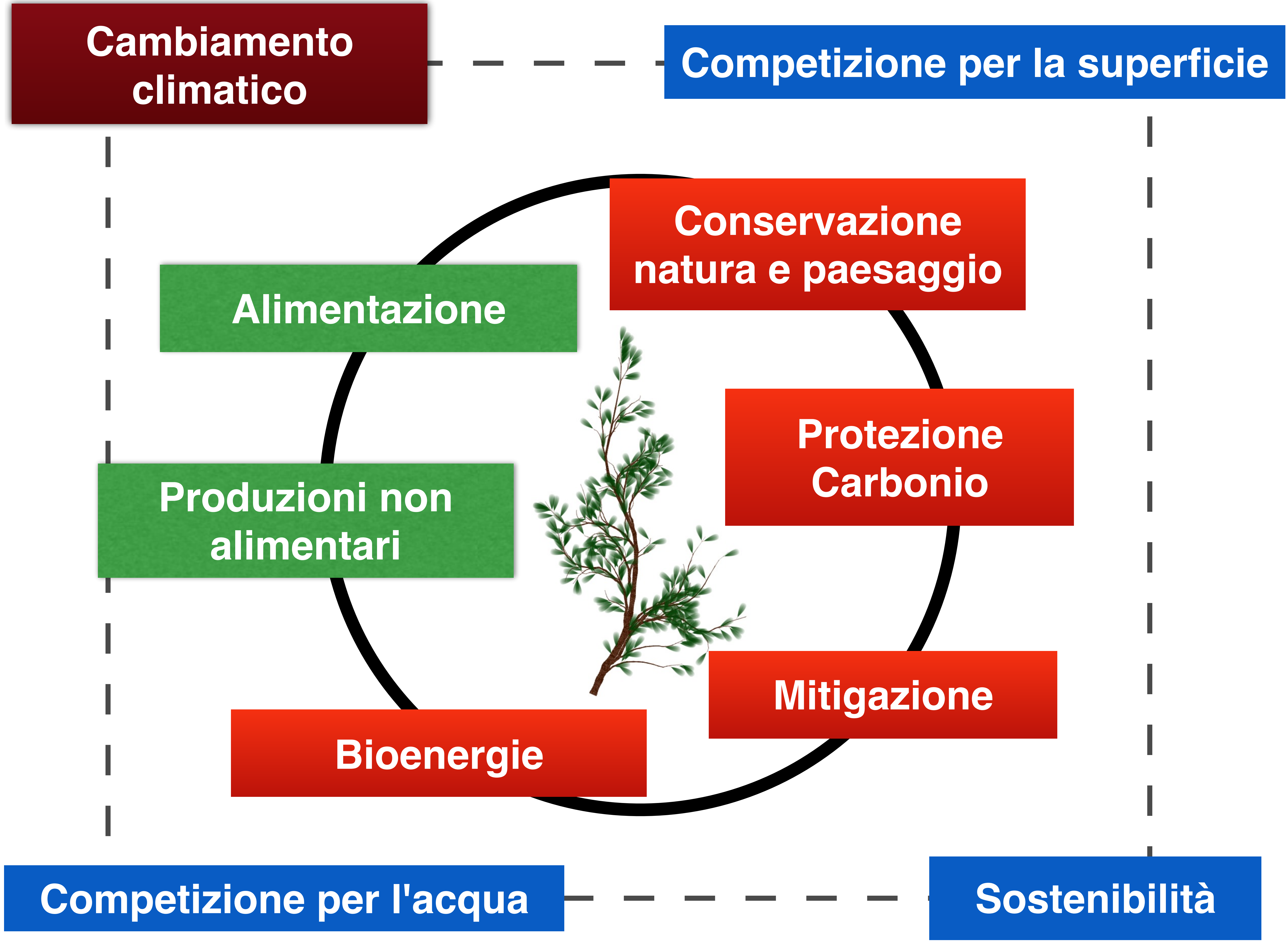
esigenze della Ricerca e prospettive future
"Aula Marconi" - CNR
Roma, 17 Ottobre 2011

Produzioni Alimentari

Produzioni non Alimentari


Cambiamento climatico
Competizione per la superficie
Conservazione natura e paesaggio
Alimentazione
Protezione Carbonio
Produzioni non alimentari
Mitigazione
Bioenergie
Competizione per l'acqua
Sostenibilità

Scenario 2050

Alimentazione

+50-70% (FAO)

- 9 miliardi di persone
- + 5% consumo alimentare pro-capite
- > 500 ppm CO_2
- > 60 ppb O_3
- +1-2 gradi di temperatura (?)
- riduzione acqua disponibile (?)
- aumento costo energia e fertilizzanti (?)
- aumento degli "sprechi" (oggi 10-40%!!!)

La foresta nel contesto del cambiamento globale

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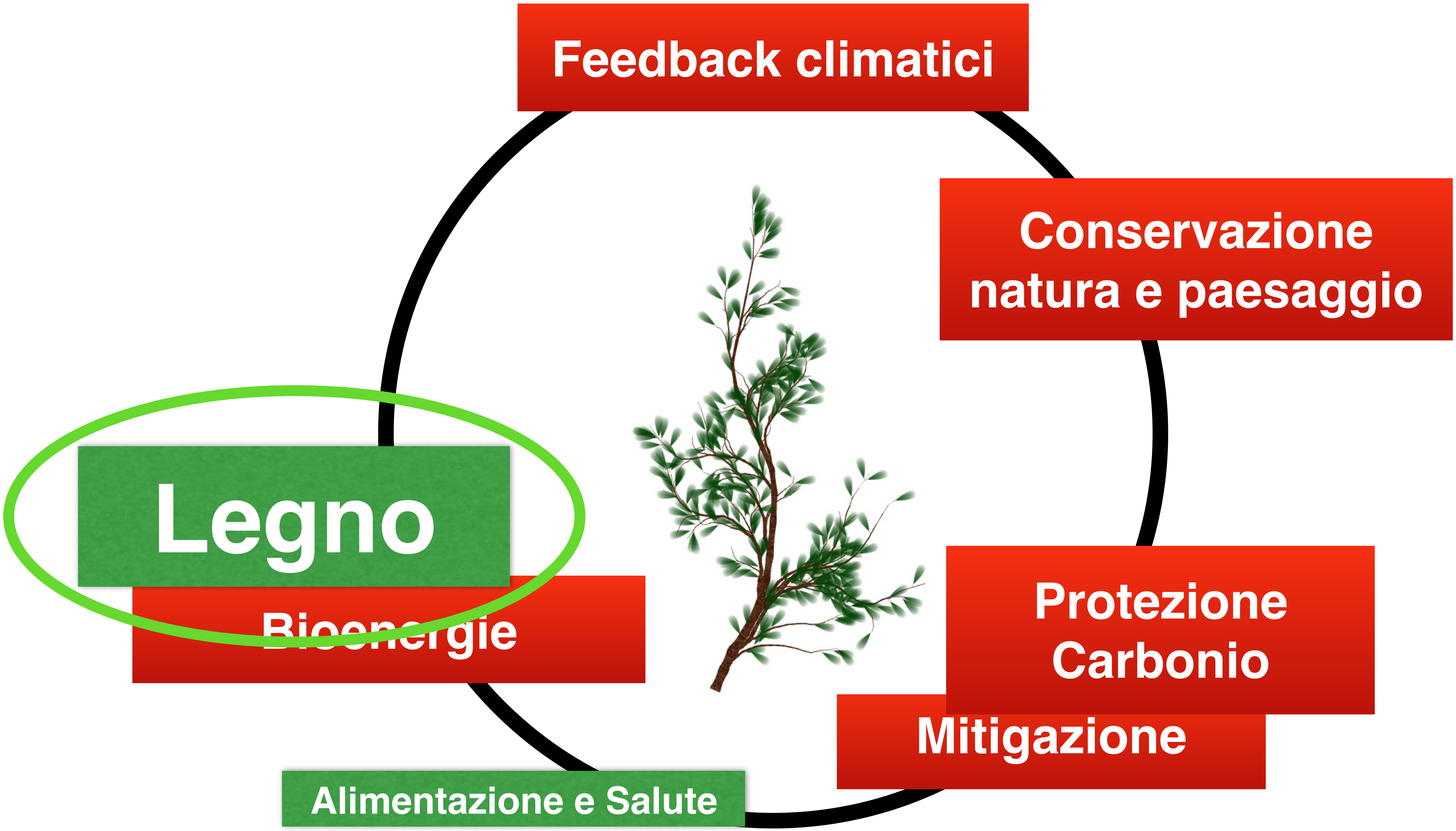
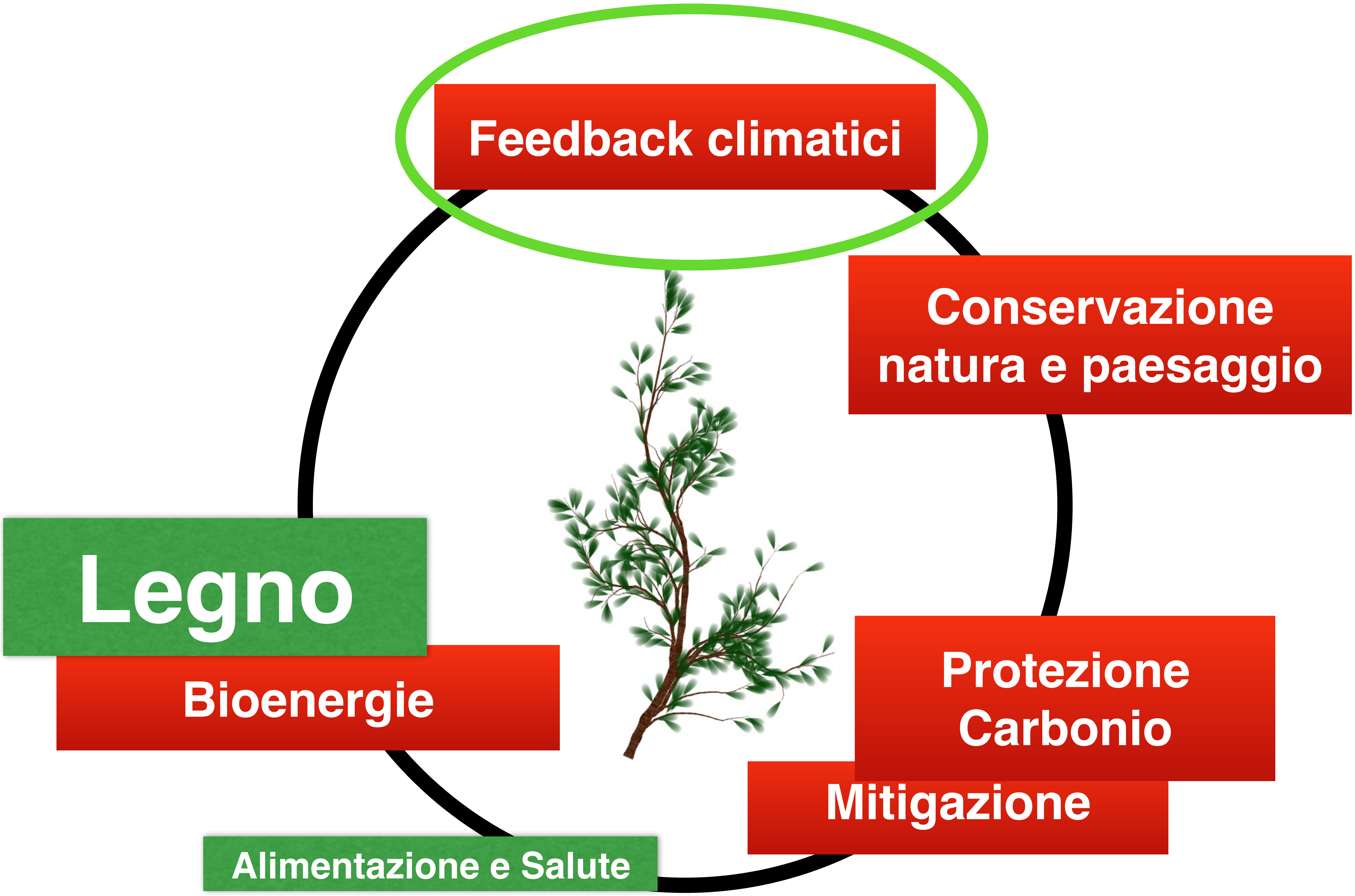


Feedback climatici
Conservazione natura e paesaggio
Legno
Bioenergie
Protezione Carbonio
Mitigazione
Alimentazione e Salute


250 cubic meters of wood = 180 t CO2
Growing time in Trentino forest: 2 hours
progettosofie


Feedback climatici
Conservazione natura e paesaggio
Legno
Bioenergie
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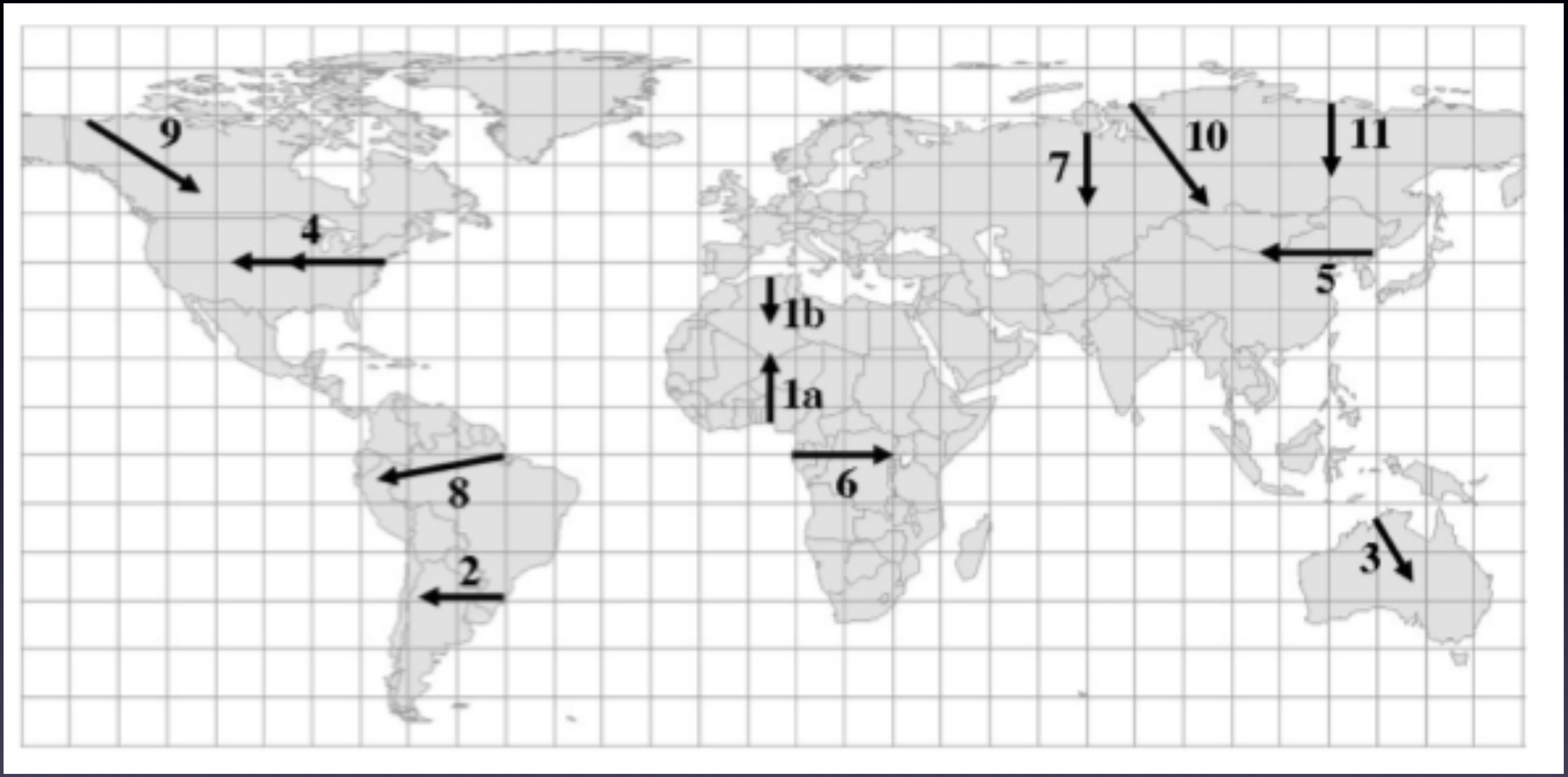
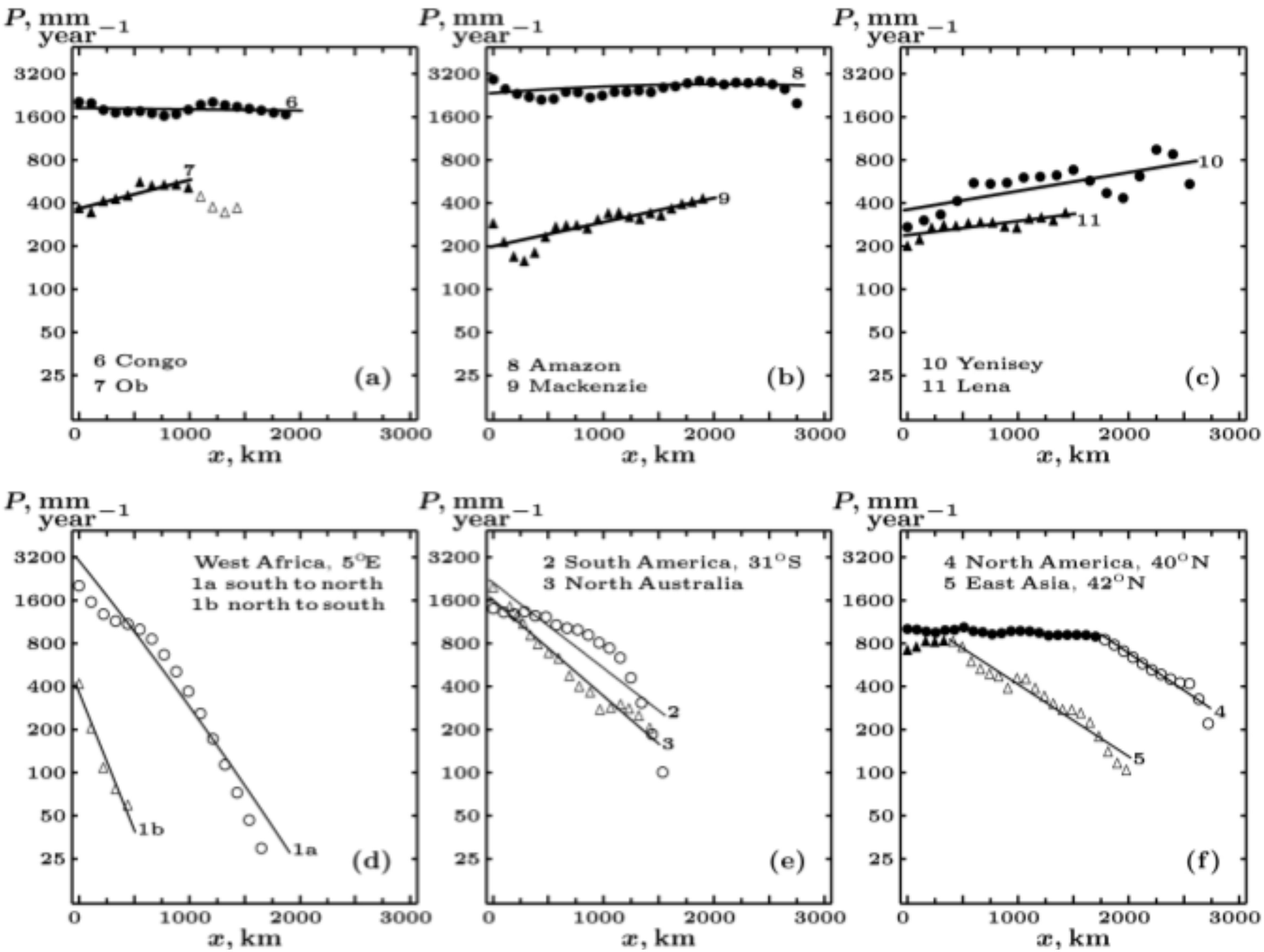
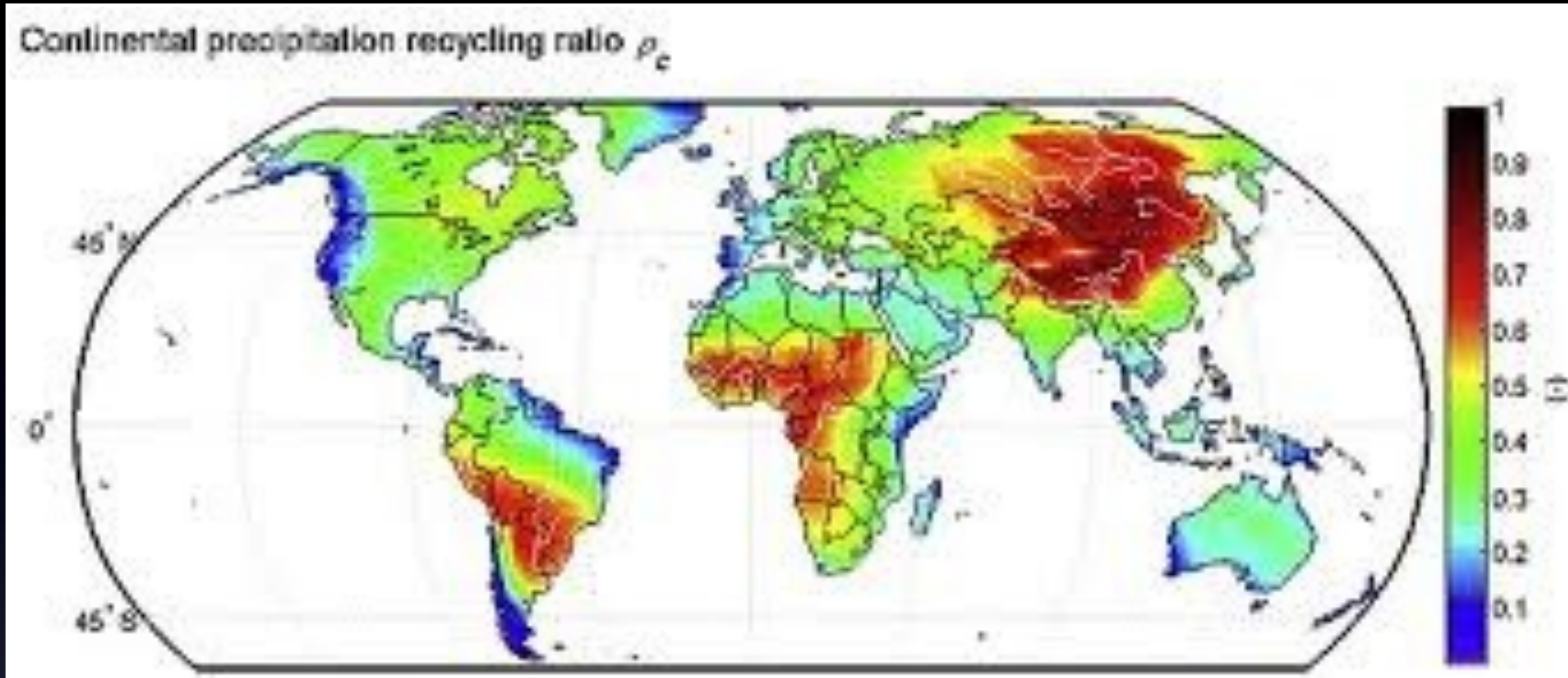
- Micro-feedback (intercettazione precipitazioni, root network, etc.)
- Macro-feedback / land-use (temperatura/precipitazione...)


9
4
8
2
1b
1a
6
7
10
11
5
3


P, mm year⁻¹
3200
1600
800
400
200
100
50
25
x, km
0
1000
2000
3000
6 Congo
7 Ob
(a)
8 Amazon
9 Mackenzie
(b)
10 Yenisey
11 Lena
(c)
West Africa, 5°E
1a south to north
1b north to south
(d)
2 South America, 31°S
3 North Australia
(e)
4 North America, 40°N
5 East Asia, 42°N
(f)



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Origin and fate of atmospheric moisture over continents

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IOP PUBLISHING ENVIRONMENTAL RESEARCH LETTERS
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Climate forcing and response to idealized changes in surface latent and sensible heat

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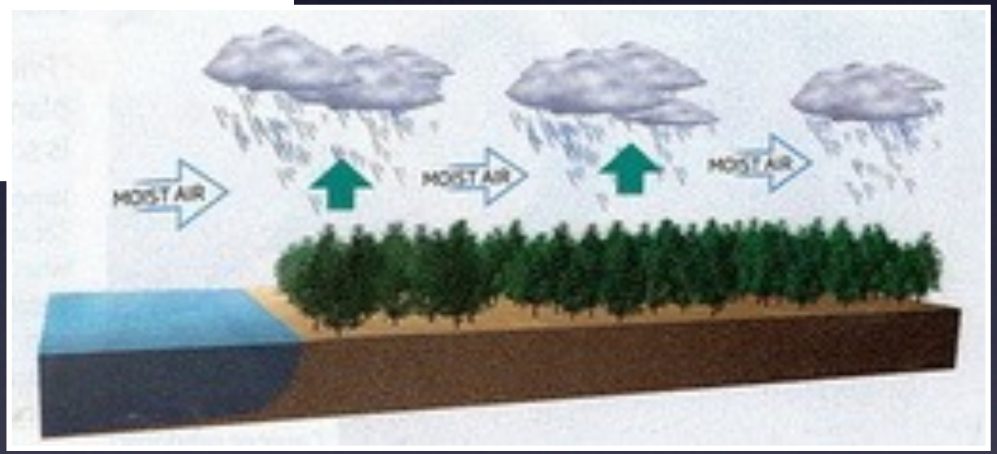
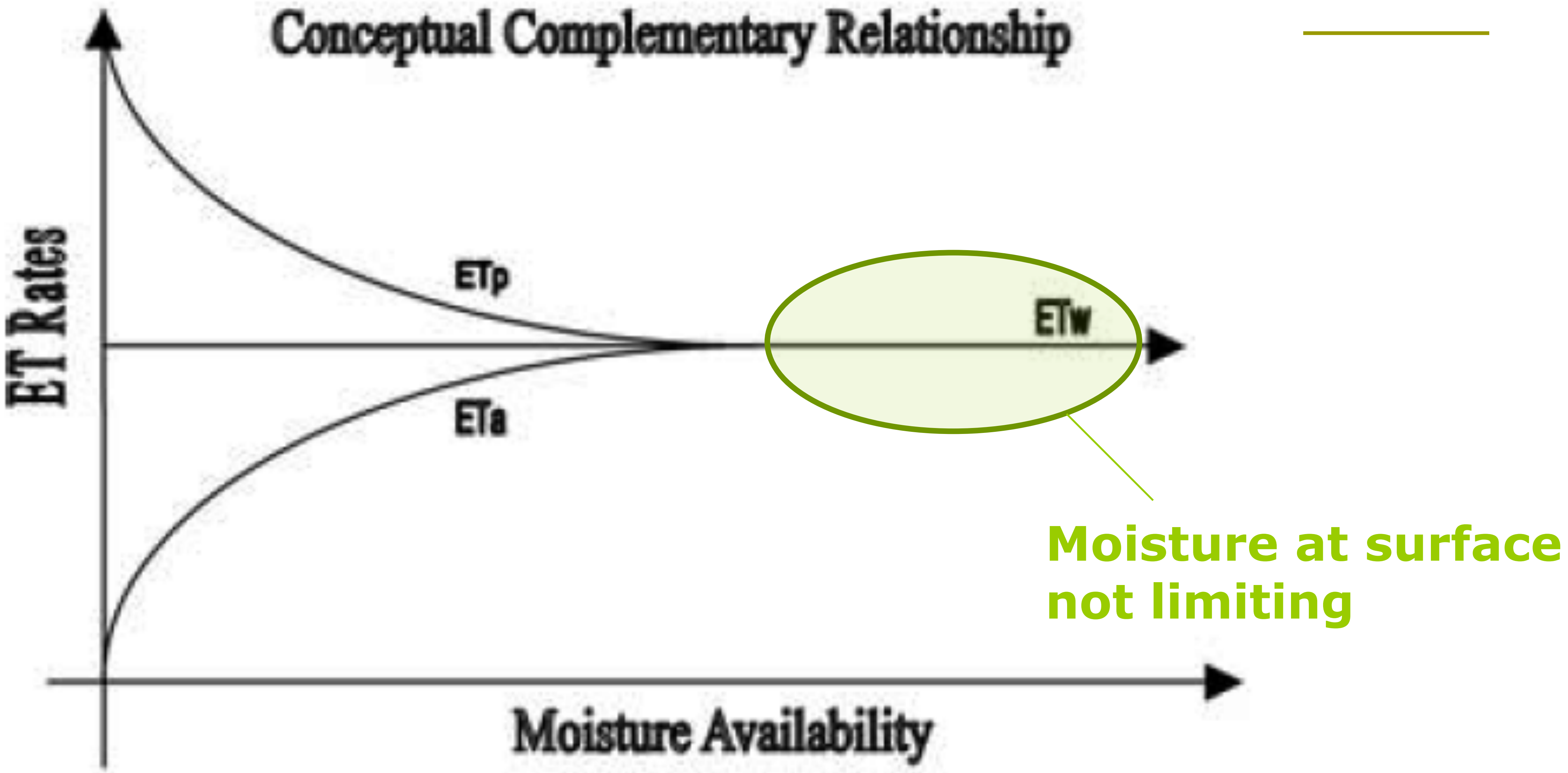
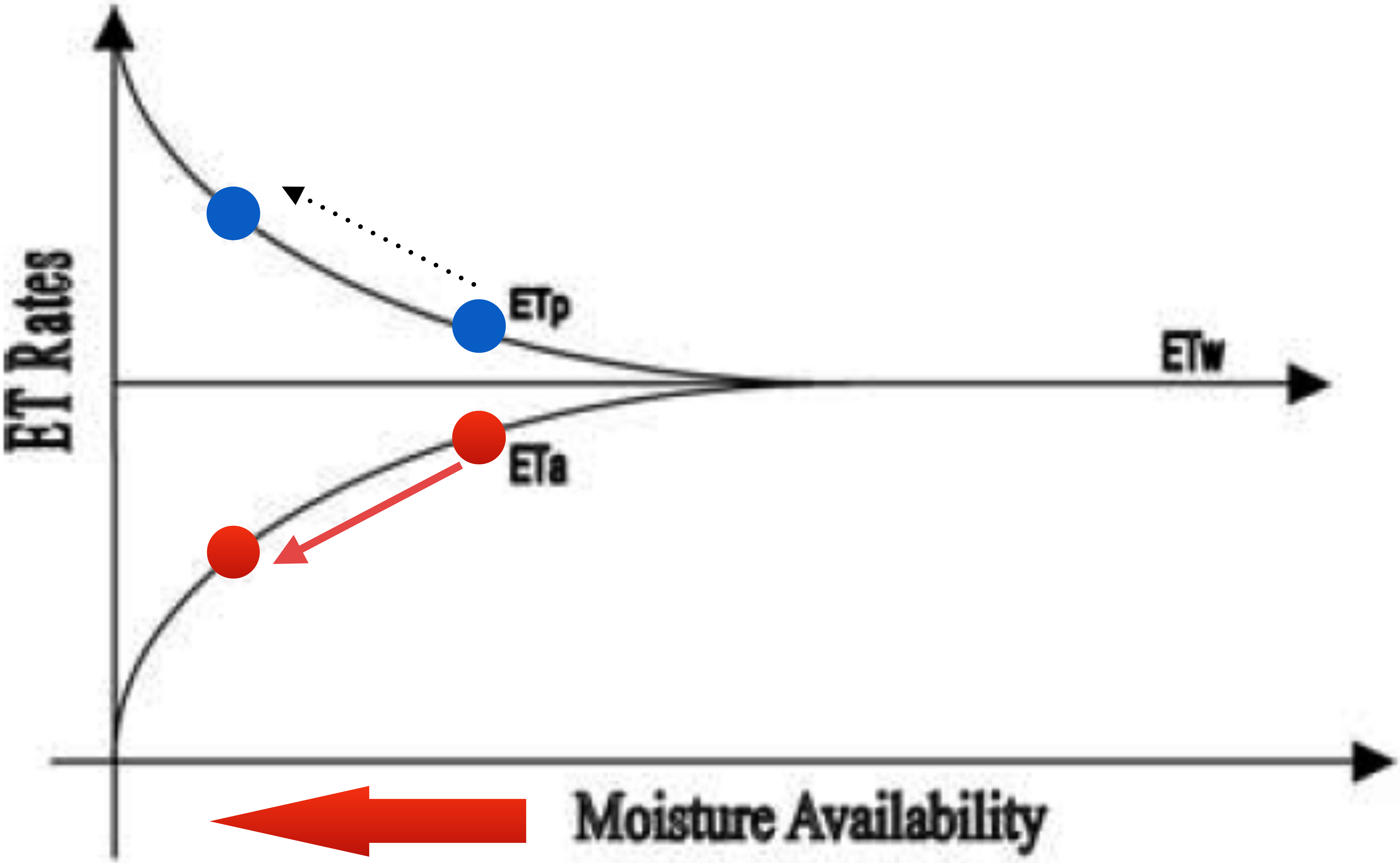


La teoria della complementarietà (CR) di Bouchet



La traspirazione potenziale e quella reale sono complementari sulla grande scala, grazie a retroazioni biosfera-atmosfera

Etp + Eta = *k* ETw   dove *k*=2


ET Rates
ETp
ETw
ETa
Moisture Availability

Land sharing & Land sparing ?

FoxLab

Reconciling Food Production and Biodiversity Conservation: Land Sharing and Land Sparing Compared

Ben Phalan,[1] Malvika Onial,[1] Andrew Balmford,[1] Rhys E. Green[1,2]

The question of how to meet rising food demand at the least cost to biodiversity requires the evaluation of two contrasting alternatives: land sharing, which integrates both objectives on the same land; and land sparing, in which high-yield farming is combined with protecting natural habitats from conversion to agriculture. To test these alternatives, we compared crop yields and densities of bird and tree species across gradients of agricultural intensity in southwest Ghana and northern India. More species were negatively affected by agriculture than benefited from it, particularly among species with small global ranges. For both taxa in both countries, land sparing is a more promising strategy for minimizing negative impacts of food production, at both current and anticipated future levels of production.

Given multiple competing demands for land, how might humanity minimize the impact on biodiversity of producing food for 9 billion people (*1–3*)? One strategy—land sharing—involves integrating biodiversity conservation and food production on the same land, using wildlife-friendly farming methods (*3–6*). A contrasting alternative—land sparing—consists of separating land for conservation from land for crops, with high-yield farming facilitating the protection of remaining natural habitats from agricultural expansion (*3–7*). Achieving land sparing is fundamental to reducing emissions from deforestation and forest degradation (REDD) and requires the sustainable intensification of agriculture (*1, 8, 9*). Land sharing is often an aim of agri-environment and certification schemes, and can result from some forms of agroforestry and organic farming (*10–13*). Increases in crop yields do not guarantee land sparing (*14–17*), and land sharing schemes do not guarantee benefits to biodiversity on farmed land (*12, 18*); instead, both approaches require careful design and implementation to be effective. Here we address a more fundamental question: Assuming that they could be implemented properly, which would do the least harm to biodiversity: land sharing or land sparing?

Answering this question requires information on variation in species' population densities among comparable areas with a range of quantified levels of crop yield (*3*). These data can be used to construct a density-yield function for each species, from which one can identify the yield that maximizes the species' total population size on farmed and unfarmed land combined, at any given level of food production (the production target) (*3*). We report this information for birds and trees in Ghana and India, where both land sharing and land sparing have been advocated for reconciling food production and biodiversity conservation (*19–22*).

We measured the mean population densities of 167 bird species and 220 tree species in 25 1-km^2 squares in Ghana, and of 174 bird species and 40 tree species in 20 1-km^2 squares in India (*23*) (figs. S1 and S2). Both study regions contained remnants of forest within a matrix of farmland ranging from diverse low-yielding mosaic agriculture to large-scale high-yielding monocultures and have experienced growth in food production through a combination of cropland expansion and yield increases. We fitted separate density-yield functions for each species, for two yield currencies (food energy and profit). From these functions, we classified species according to whether (i) their total population on farmed and unfarmed land combined was higher or lower than that if the province was all forested, and (ii) their total population on farmed and unfarmed land combined was highest if land was farmed at the lowest permissible yield (land sharing), at the highest permissible yield (land sparing), or at an intermediate yield (*3*).

Most species had density-yield curves with one of four simple forms (Fig. 1, A to D; proportions are shown in Fig. 1E). We defined as winners those species with higher total populations with agriculture, at all permissible yields, than in the all-forest baseline (Fig. 1, A and B). Changing the extent and intensity of agriculture is unlikely to threaten them. We defined as losers those species that had lower total populations when there was farming (Fig. 1, C and D, and fig. S3, A, B, and F). The total population for species with more complex density-yield functions can be greater or less than the baseline population, depending on yield (fig. S3, C to F): We conservatively included as losers those species with lower than baseline populations at any permissible yield for a given production target, regardless of whether they had larger populations at

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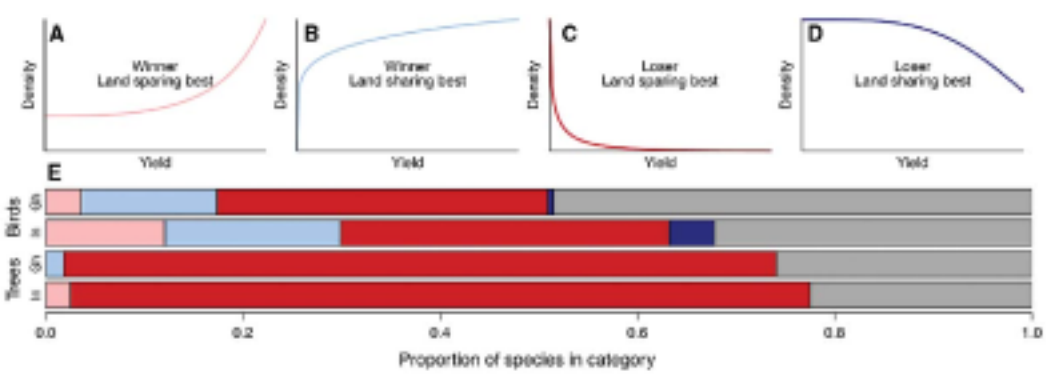

Fig. 1. Representative examples of functions relating population density to food energy yield, and their frequency among birds and trees in southwest Ghana (Gh) and northern India (In). Species with the lowest density in forest (**A** and **B**) are winners because their total population size (on farmland and unconverted land combined) is always higher when the study province contains farmed land than when it does not. Those with density on farmed land lower than that in forest at some or all permissible yields (**C** and **D**) are losers, because their total population can be lower than that expected if the whole province is forested. At any production target, species with convex density-yield functions [(A) and (C)] have highest total populations under a land sparing (highest permissible yield) strategy, whereas those with concave functions [(B) and (D)] have highest total populations under a land sharing (lowest permissible yield) strategy. Colored bars in (**E**) indicate the proportion of species with each type of curve. Various other more complex functions (gray parts of bars; fig. S3) can only be categorized as winner/loser and/or by optimal strategy at specific production targets, because the categories change with the production target: This further categorization is presented in Fig. 2 (*23*). *N* = 167 Ghana birds, 220 Ghana trees, 174 India birds, and 40 India trees.

ANALYSIS

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Solutions for a cultivated planet

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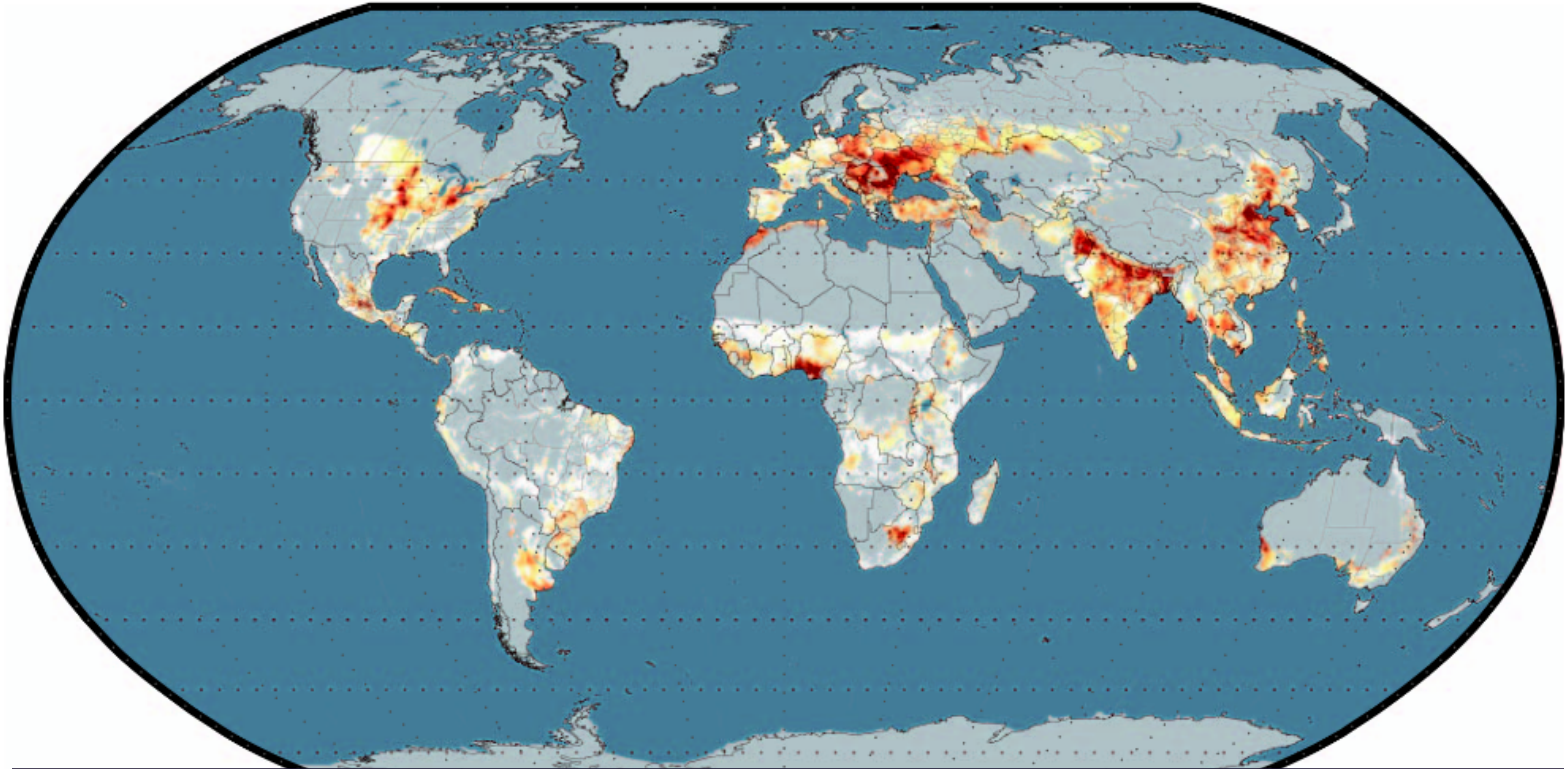
Increasing population and consumption are placing unprecedented demands on agriculture and natural resources. Today, approximately a billion people are chronically malnourished while our agricultural systems are concurrently degrading land, water, biodiversity and climate on a global scale. To meet the world's future food security and sustainability needs, food production must grow substantially while, at the same time, agriculture's environmental footprint must shrink dramatically. Here we analyse solutions to this dilemma, showing that tremendous progress could be made by halting agricultural expansion, closing 'yield gaps' on underperforming lands, increasing cropping efficiency, shifting diets and reducing waste. Together, these strategies could double food production while greatly reducing the environmental impacts of agriculture.



- Chiudere gli "yield gaps"
- Aumentare l'efficienza agricola
- Migliorare la distribuzione e ridurrre lo spreco

Conclusioni

- capire la funzione globale del sistema forestale
- superare visioni <u>solo</u> riduzionistiche nella ricerca
- integrare studi-analisi-politiche agricole e forestali
- identificare modelli *sostenibili* di uso del territorio

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