Virtual Water in The Rural Sector of Argentina, Brazil, Paraguay And Uruguay and Its Potential Impact on Global Water Security

GPS

PARAGUAY • URUGUAY • ARGENTINA • BRAZIL

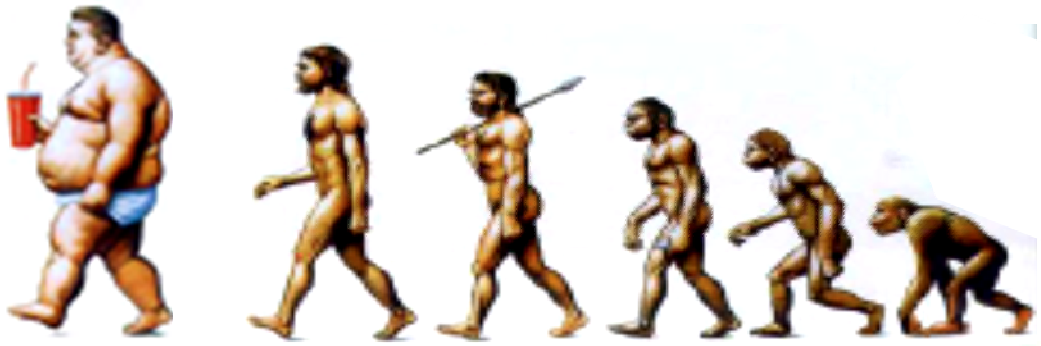
GRUPO DE PAÍSES PRODUCTORES DEL SUR

GROUP OF PRODUCING COUNTRIES FROM THE SOUTHERN CONE

Ernesto Viglizzo

Berlin's International Green Week

January 20th 2017



Beyond the Footprint

Two Tales on Water, Carbon and Food

E. F. Viglizzo & M. F. Ricard
GPS (Group of Producing Countries from the Southern Cone)

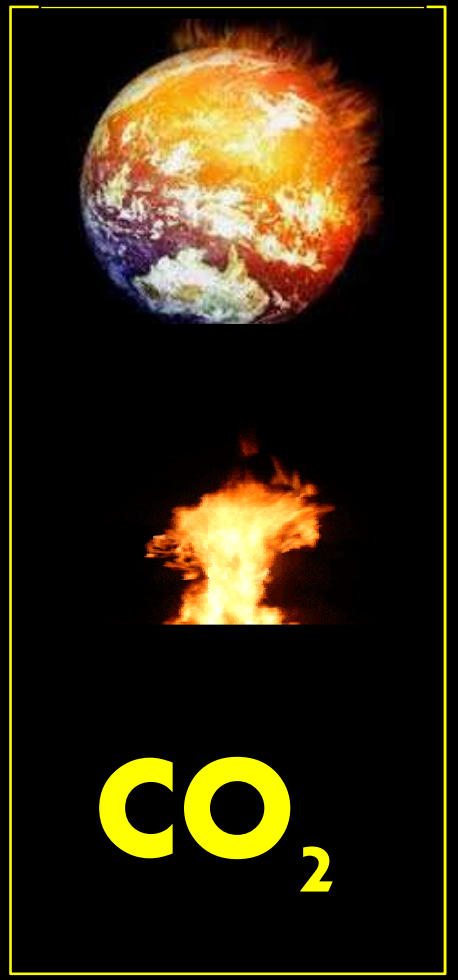
The aim of this lecture is to put in context the question of water use, carbon emission and food production in the ABPU Region (Argentina, Brazil, Paraguay and Uruguay)

The ABPU Region plays a relevant role in global food and water security by providing about

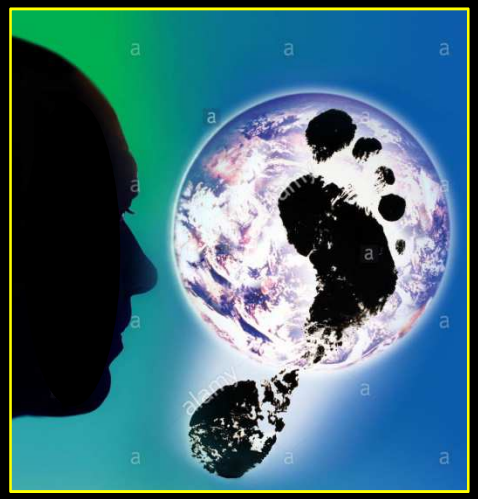
43 % of grain (cereal + oilseed) demand

30 % of beef demand

The use of water and the emission of GHG throughout the food chain are subjected to increasing scrutiny by academics and scientists, by policy makers and even by the business community



CO_2



The small tale

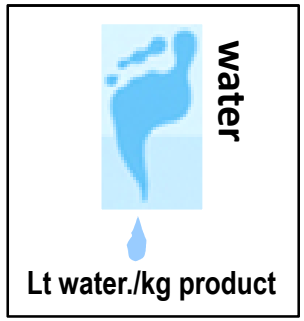
The water and the carbon footprint

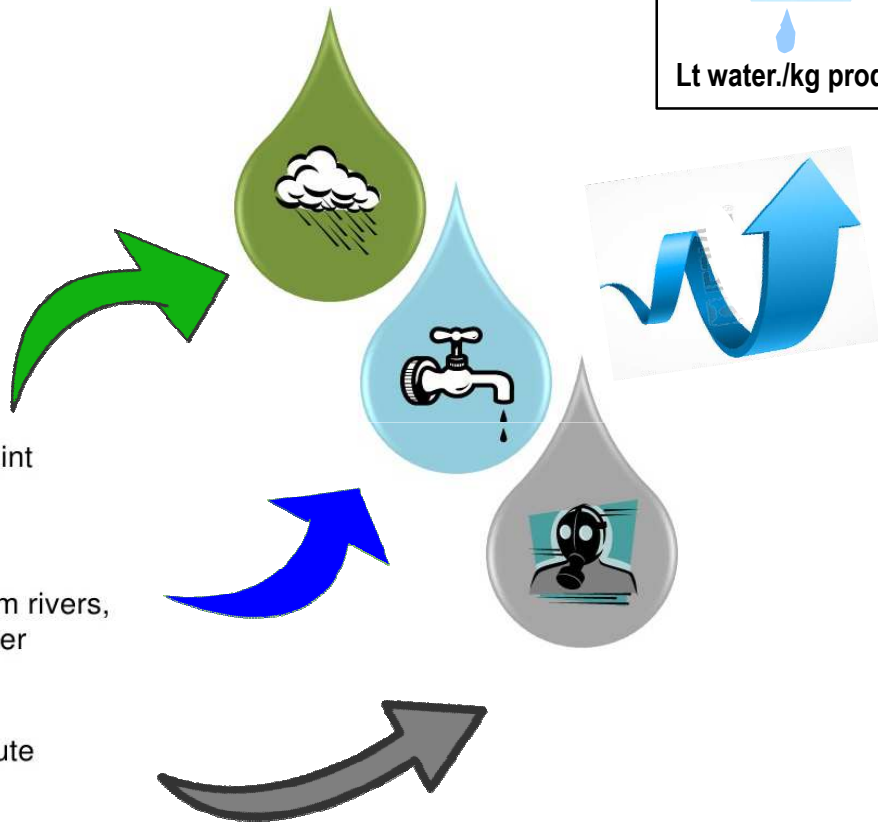
Water Footprint

Is a measure of the total volume of freshwater used throughout the food chain to produce 1 kg of a given product.

Carbon Footprint

Is a measure of the total emission of greenhouse gases (GHG) throughout the life cycle of a given product, starting with inputs used for manufacturing to the final disposal of the product after being consumed. It is expressed in terms of CO_2 equivalents per kg of product.





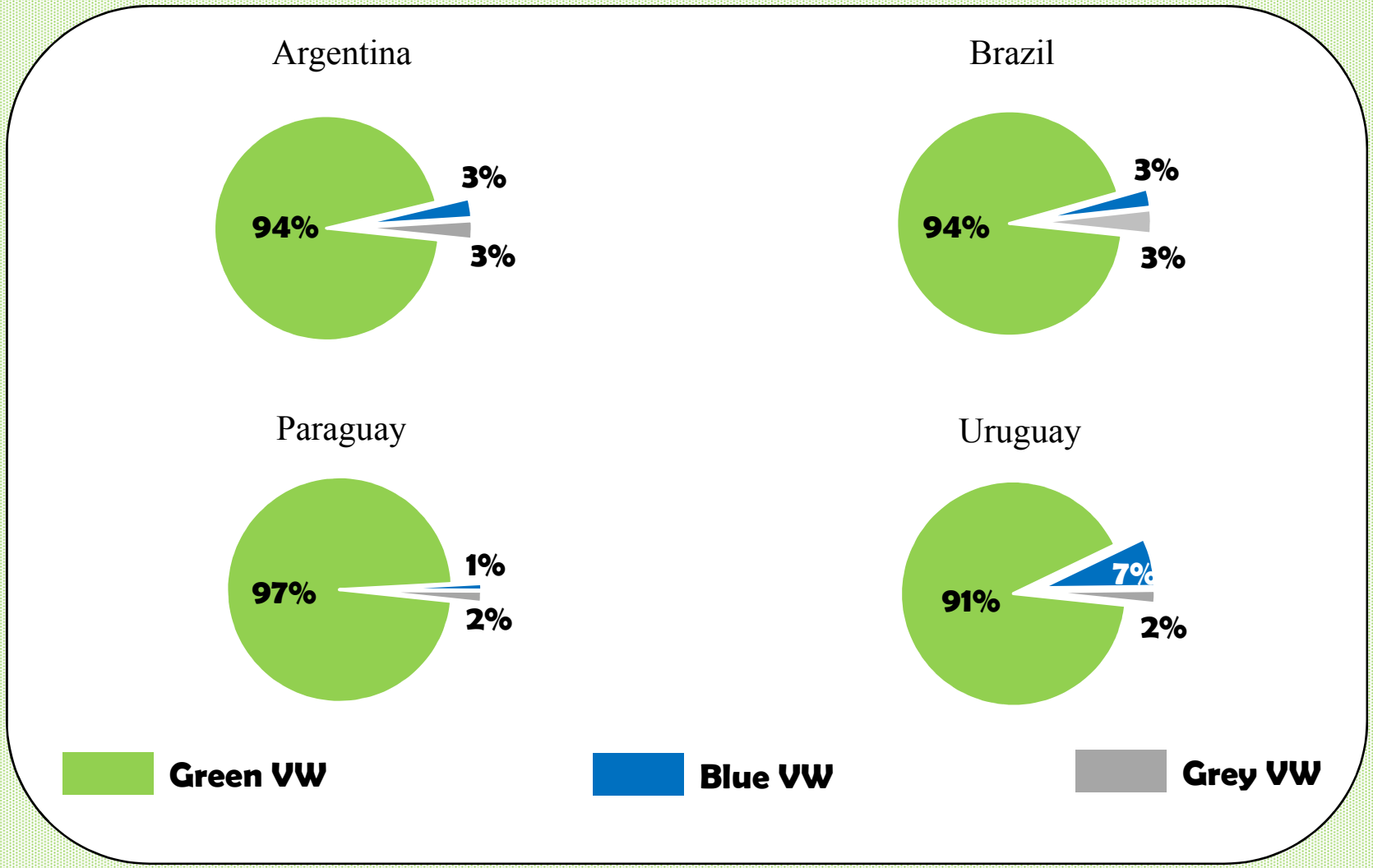
Green Water — Water used at the point where rain falls

Blue Water — Water abstracted from rivers, lakes and groundwater

Grey Water — Water required to dilute polluted return flows

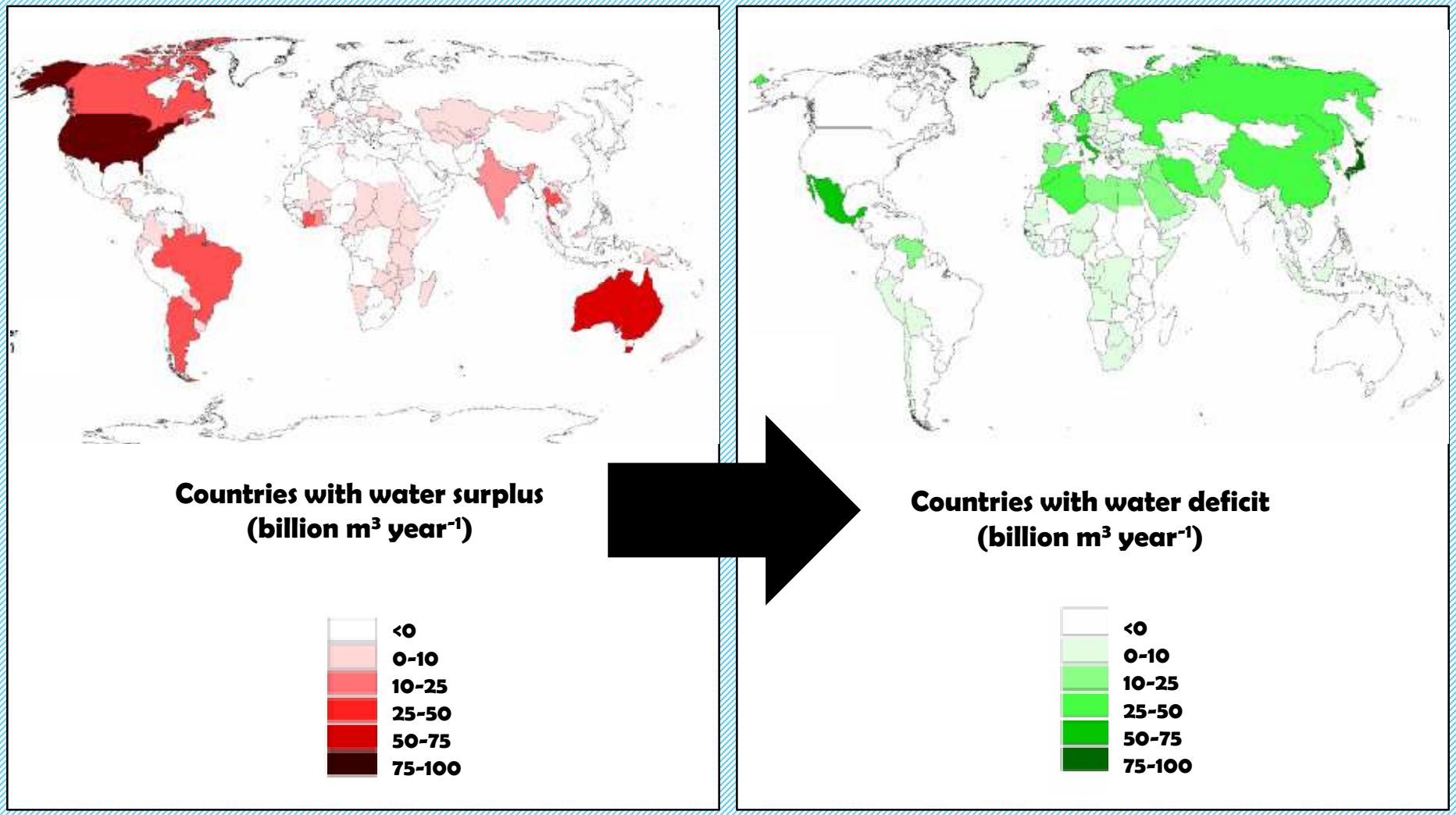
What makes up our water footprint?

The ABPU region relies almost entirely on rainfall water (between 90-97%) to produce food.



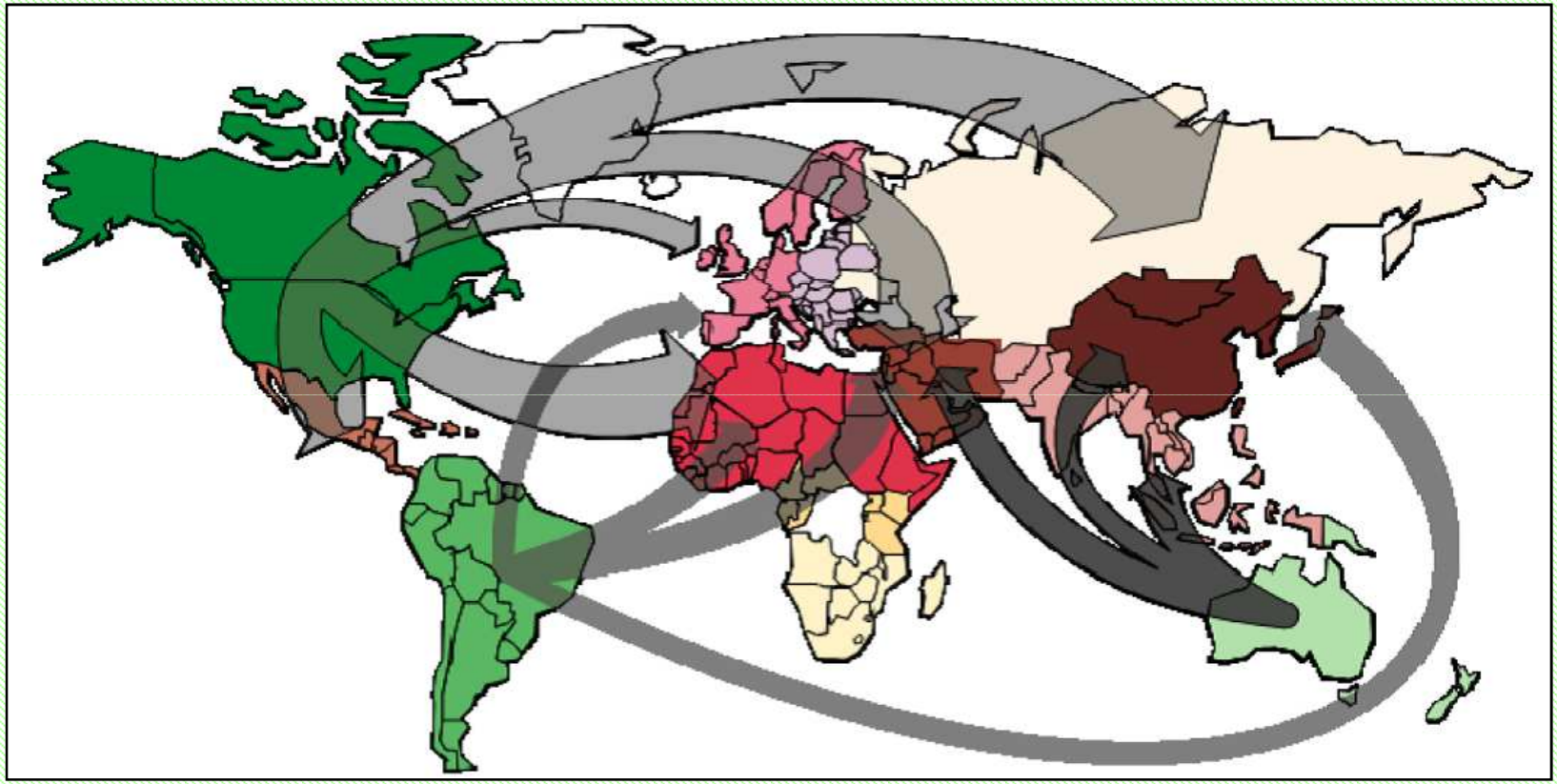
Partition of virtual water provided by agricultural products in the ABPU countries. Average for period 1996-2005. ***Sources: Mekonnen Hoekstra (2011) and Ricard & Viglizzo (2016)***

There is a flux of water embodied in food from water-rich to water-scarce countries

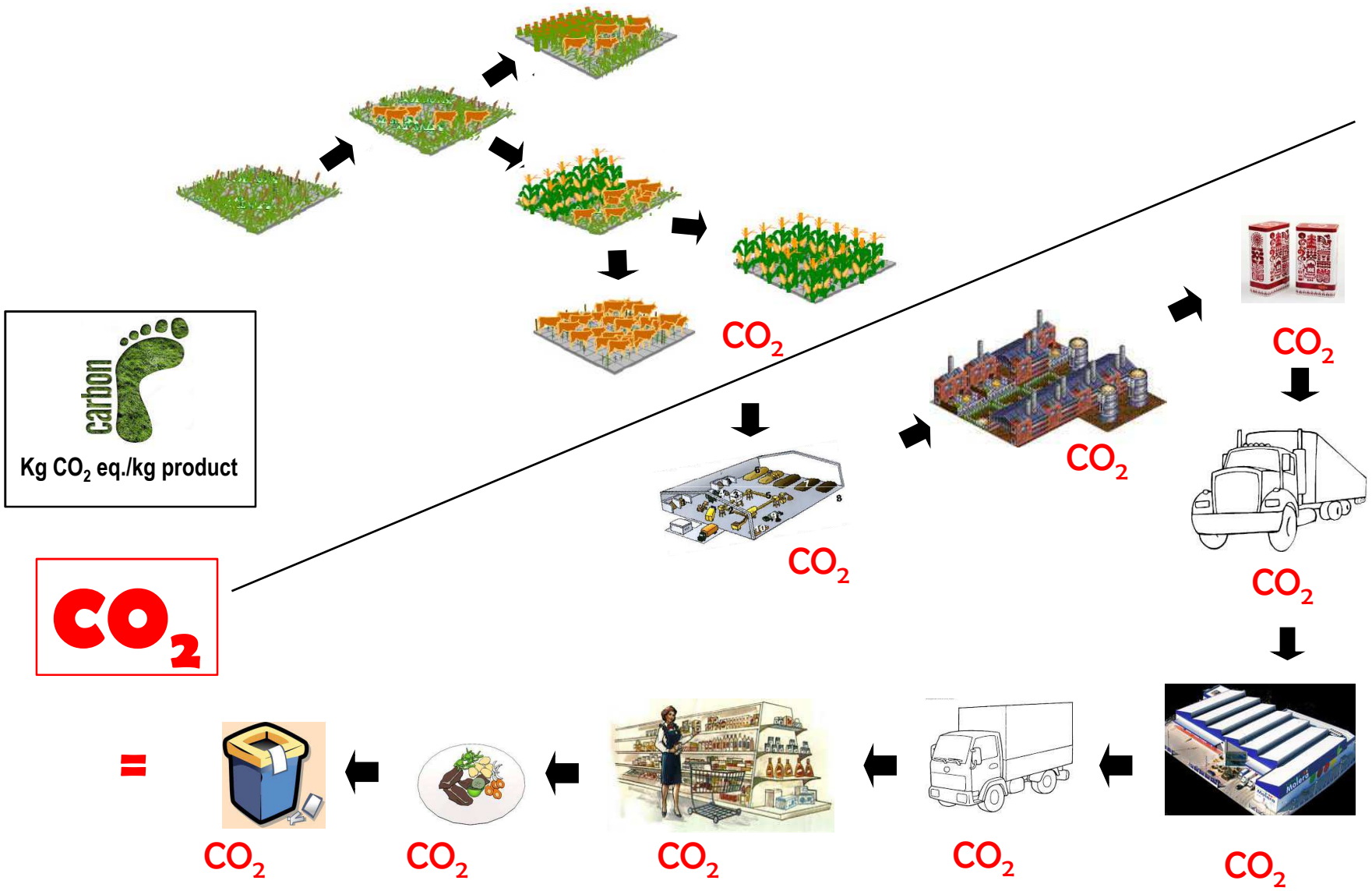


Countries with water surplus and water deficit *(Source: Chapagain et al., 2006).*

Estimations indicate that food exported from ABPU region to water-scarce countries would balance the water demand of 700 million people



International trade of virtual water contained in food
(Source: Hoekstra y Mekonnen, 2012).

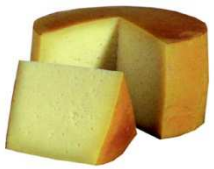


Sum of carbon emissions through the whole food chain (Life Cycle Assessment)

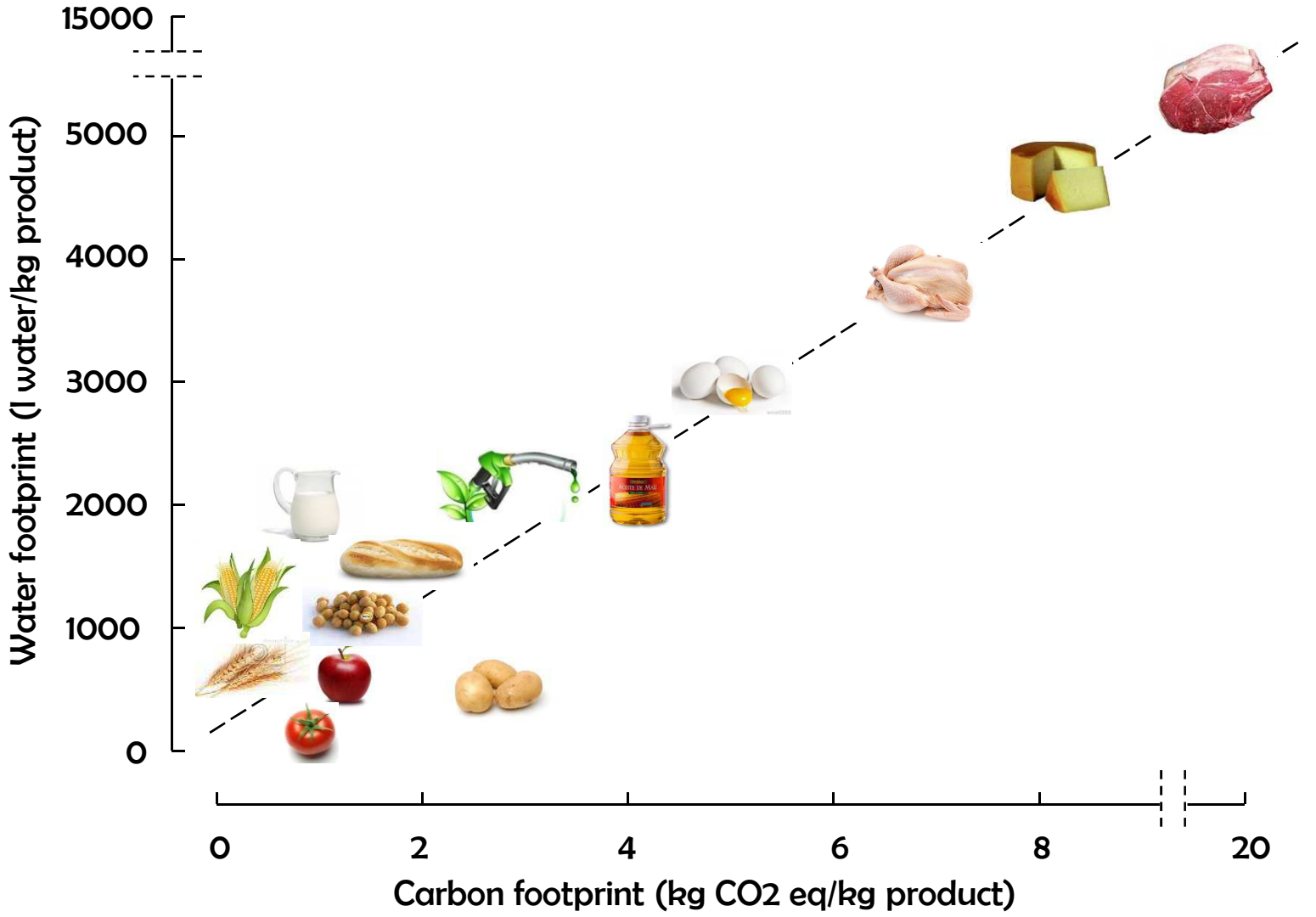
		Kg CO_2 eq./kg product	Lt water./kg product
Apple		1.3	700
Tomato		1.1	180
Potato		2.9	250
Egg		4.8	3200
Chicken		6.9	3900
Beef		17.0	15500

Figures on carbon and water footprint of non-processed plant and animal products

Kg CO_2 eq./kg product

Wheat		0.27	0.45		*Wheat bread*
Soybean		0.65	2.28		*Soybean biodiesel*
Maize		0.65	4.29		*Maize oil*
Milk		1.22	8.50		*Cheese*

Carbon footprint (kg CO2-equiv./kg product) of processed and non-processed foods



Relationship between the water and the carbon footprint of plant, animal and processed products

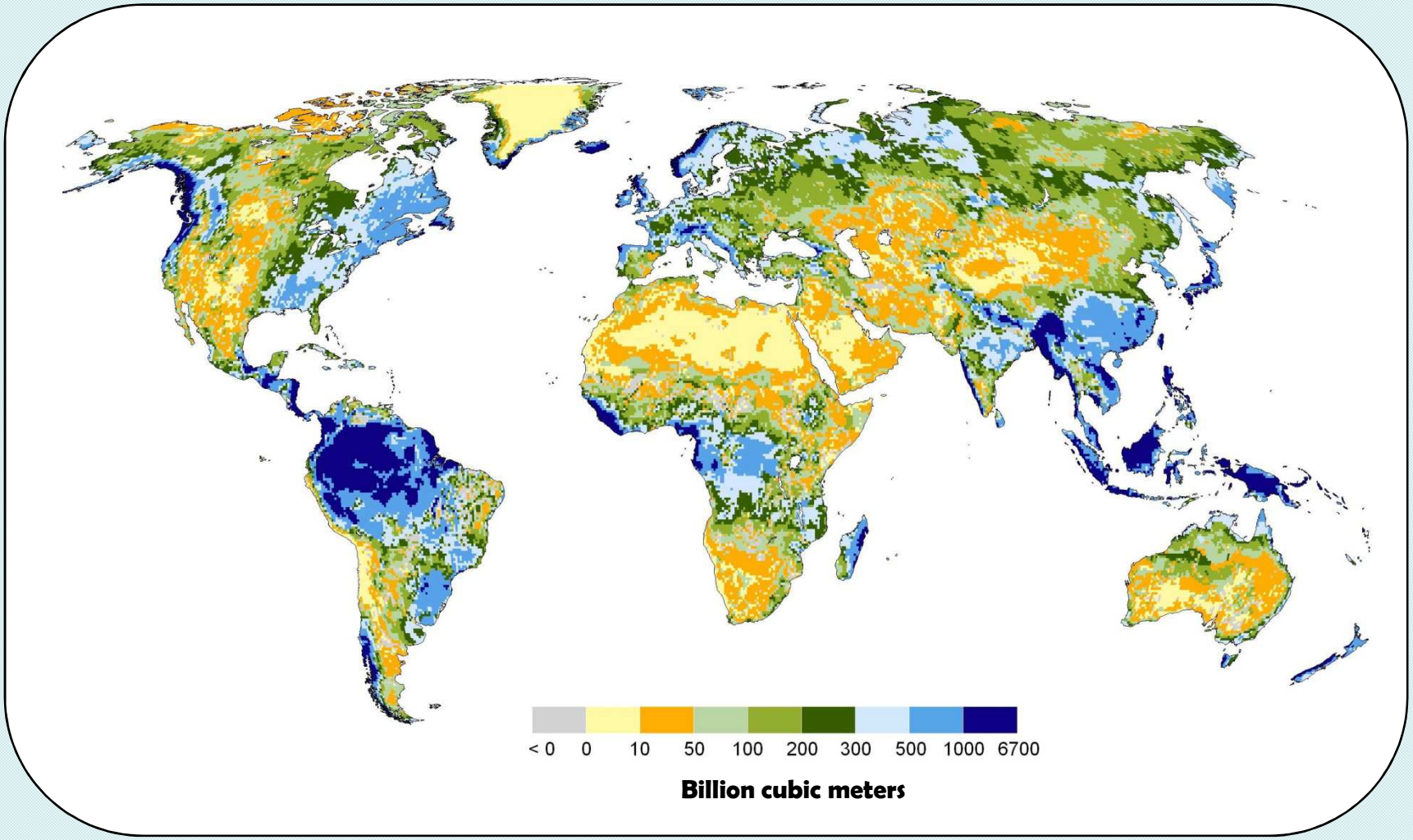
The big tale

The issue of water and carbon in ABPU region and the world

What is the practical impact of ABPU footprints on the global balance of water and carbon?

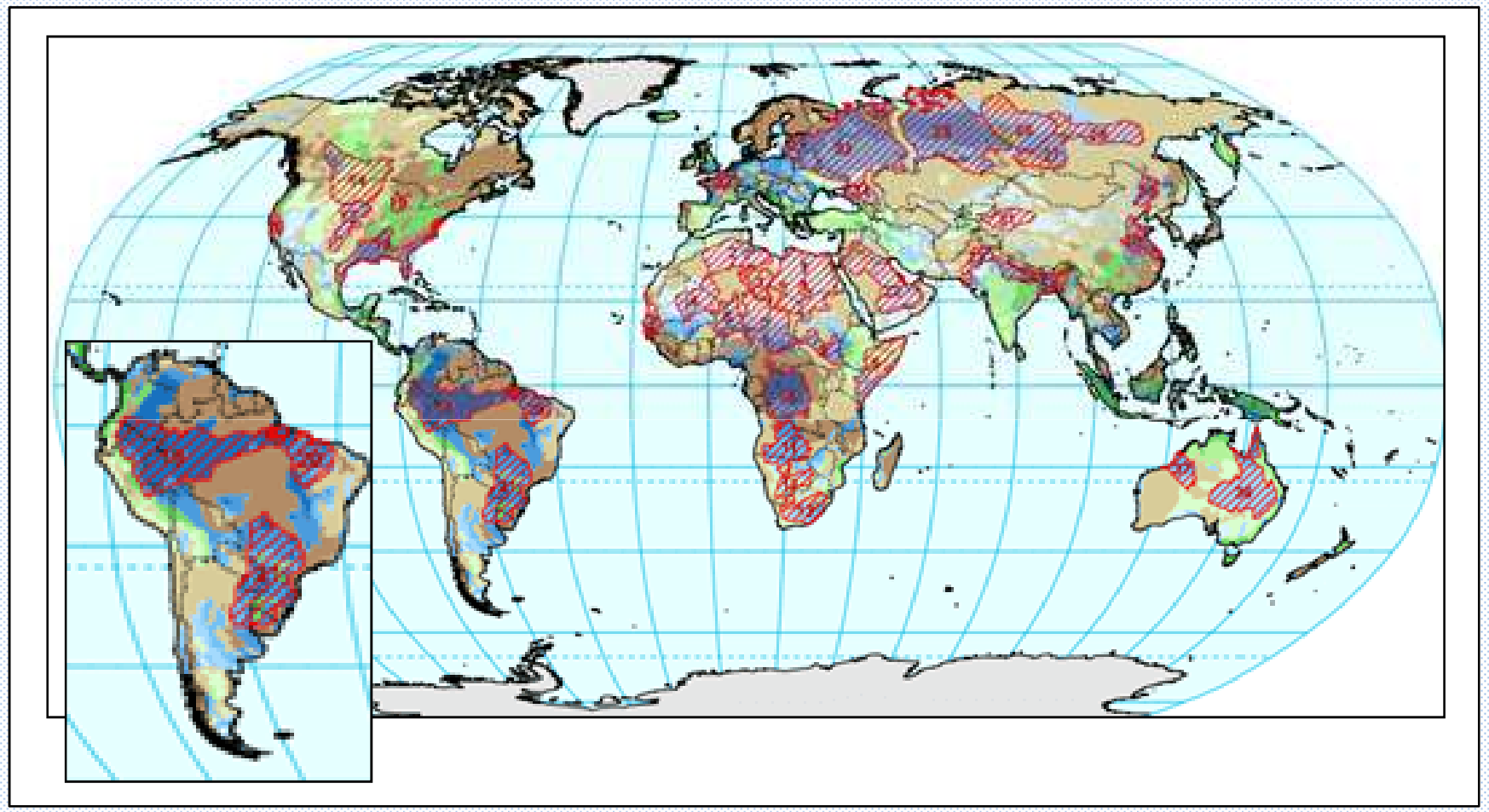
Water

The ABPU region amounts more than 15 % of renewable freshwater resources of the world, and more than 50 % of freshwater resources of South America.



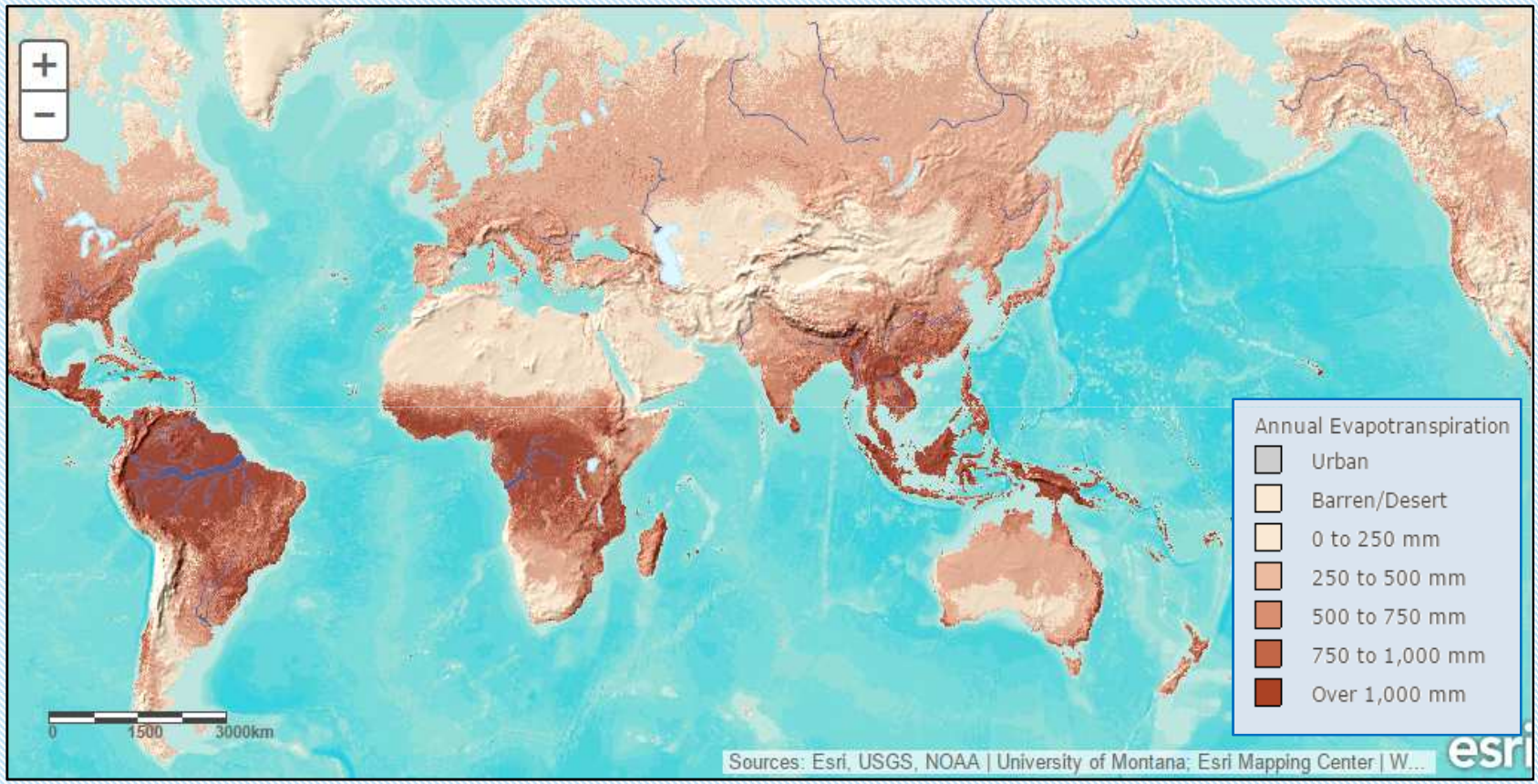
Global representation of total renewable freshwater resources. (*Source: Brooks 2016*).

Large underground aquifers are available in ABPU region



Water resources in underground aquifers. ***Source: BGR Hannover/UNESCO (2008).***

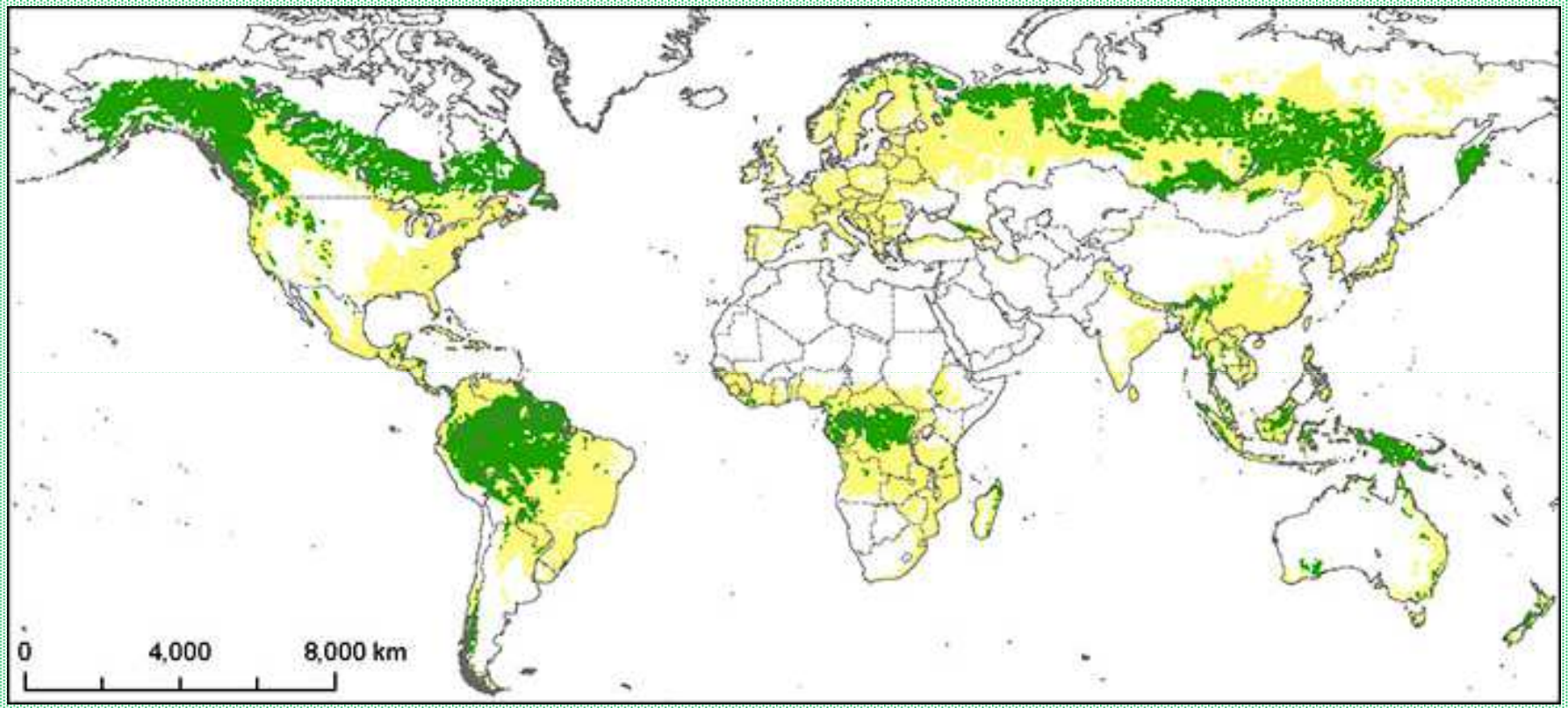
Land and vegetation in ABPU region evaporates and transpires more than 15 % of the total world evapotranspiration, supporting the global hydrological cycle.



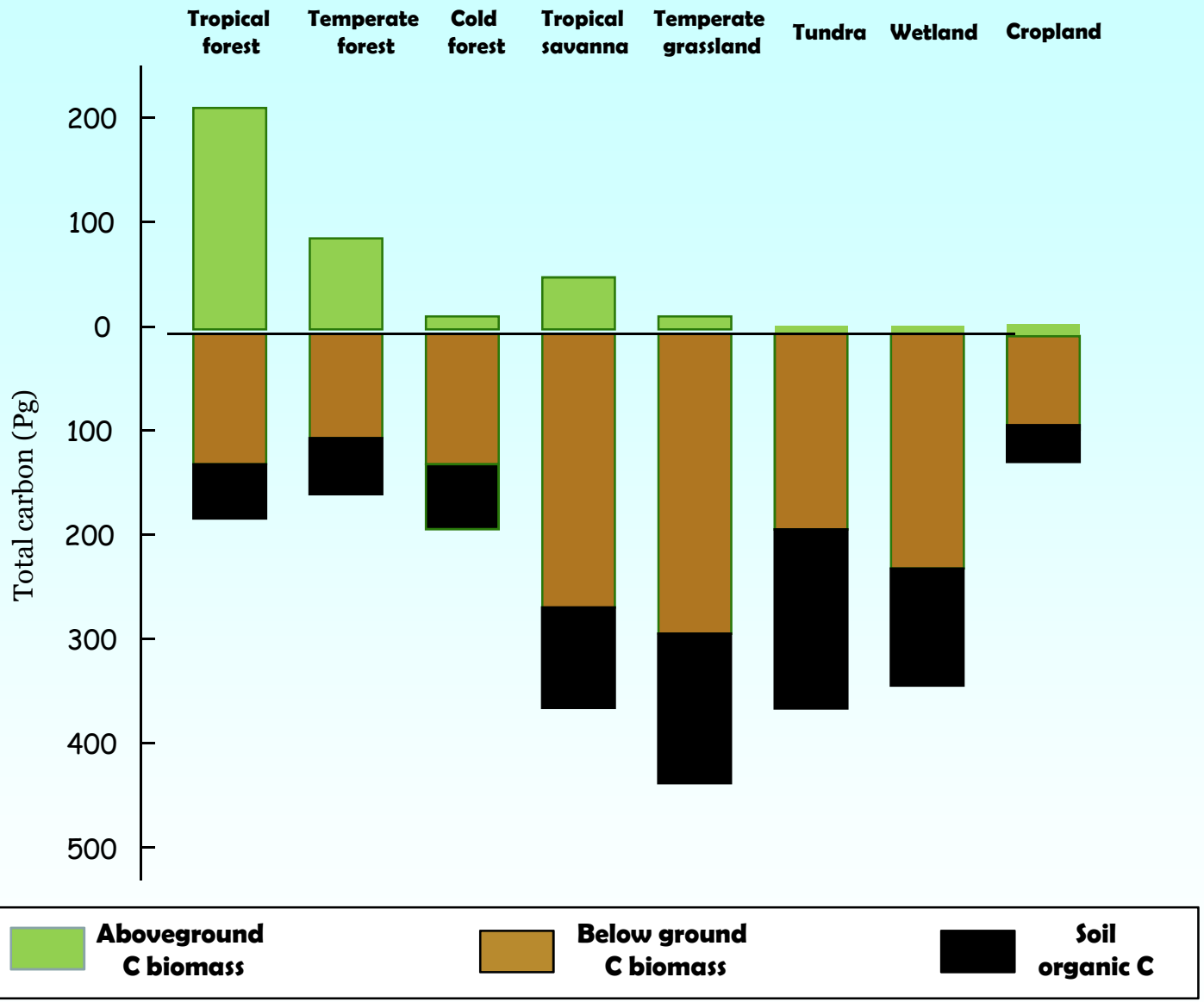
Mean evapotranspiration rate (mm/year) in different regions of the world. *Source; UUGS/NOAA/Montana University (2015).*

Carbon

Original forests were devastated everywhere across the world in different stages of the human history, affecting the global balance of carbon in the atmosphere.

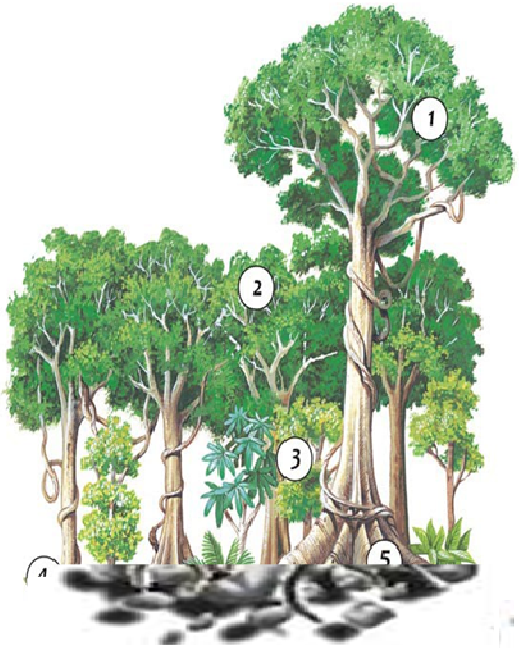


Global map showing in yellow the forest area that was transformed by human action. "Intact forests" in green. *Source. Potapov et al. (2008).*



Organic carbon storage in above-, below-ground biomass and soil.
1 Pg = 1 billion ton *(Sources: Ravindranath and Ostwald 2008, FAO 2011)*

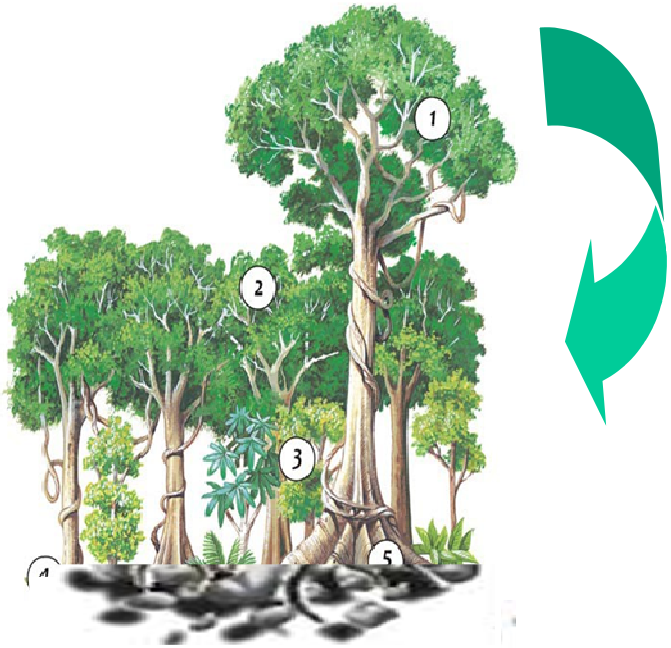
Tropical forest	Subtropical forest	Temperate forest	Cold forest



20 %	17 %	31 %	41 %

Relative weight (%) of roots in total biomass in forests of different climate regions. Average figures of 82 study cases *(Source Vogt et al., 1996)*

Tropical forest



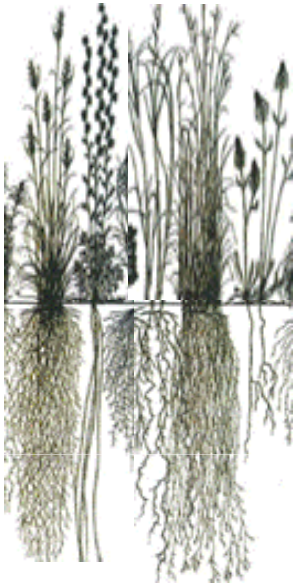
20 %

Cold forest

41 %

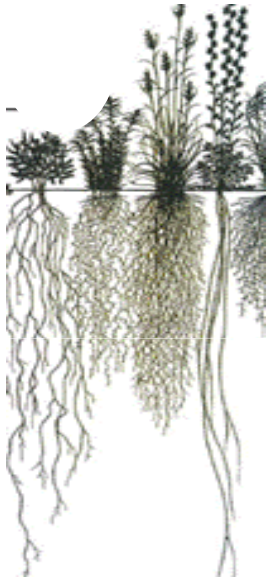
Carbon cycling between above- and below-ground fractions in forests of different climate regions

As the environment becomes more hostile, the ecosystem tends to route and store more carbon below the ground than above the ground.



tropical savanna

1-1



temperate grassland

1-3

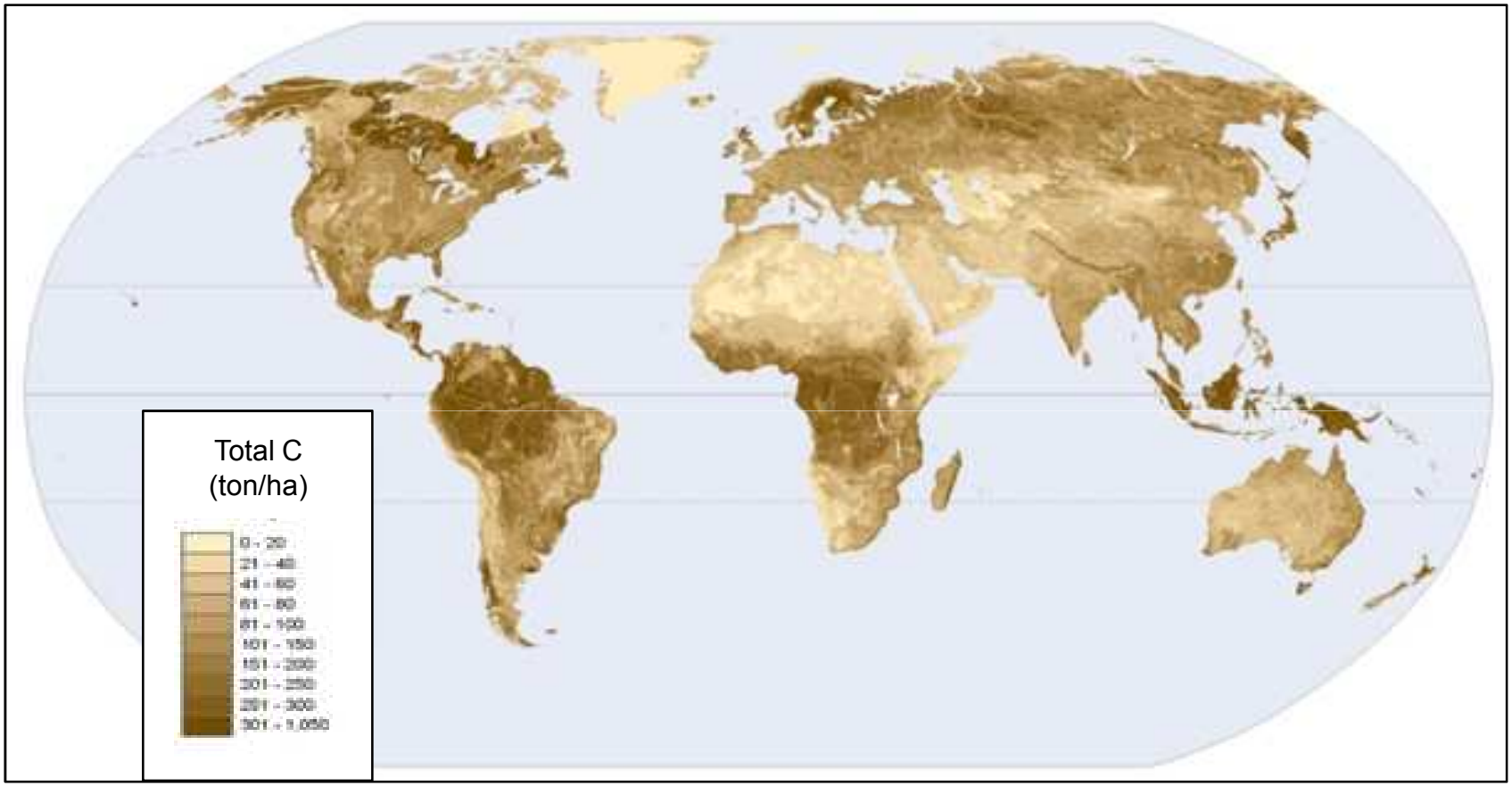
steppe & tundra

1-4

Approximate estimation of aboveground-belowground relationship of biomass (ton dry matter) in grasslands and savannas of tropical, temperate and cold regions (*Source: IPPC, 2006*)

Large variability of carbon fractions in dominant biomes of the ABPU region

The ABPU region contains 12 % of the world aboveground biomass, and 6,5 % of total carbon contained in above- and below-ground biomass and soil

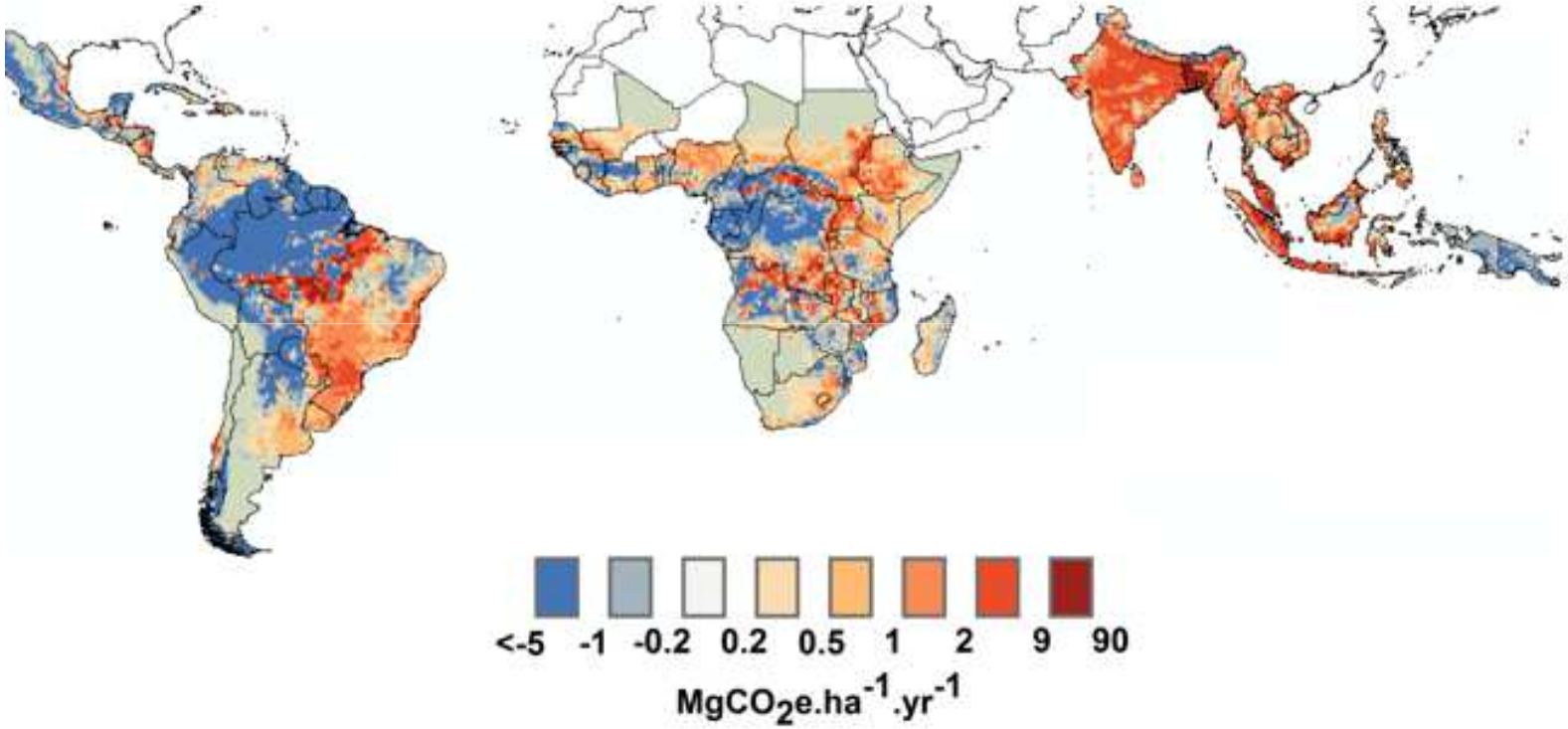


Global carbon density in above-, below-ground biomass and soil organic carbon.
Sources: Batjes (1996); FAO/IIASA/ISRIC-CAS/JRC (2009); Ruesch et al. (2008).

GHG emissions

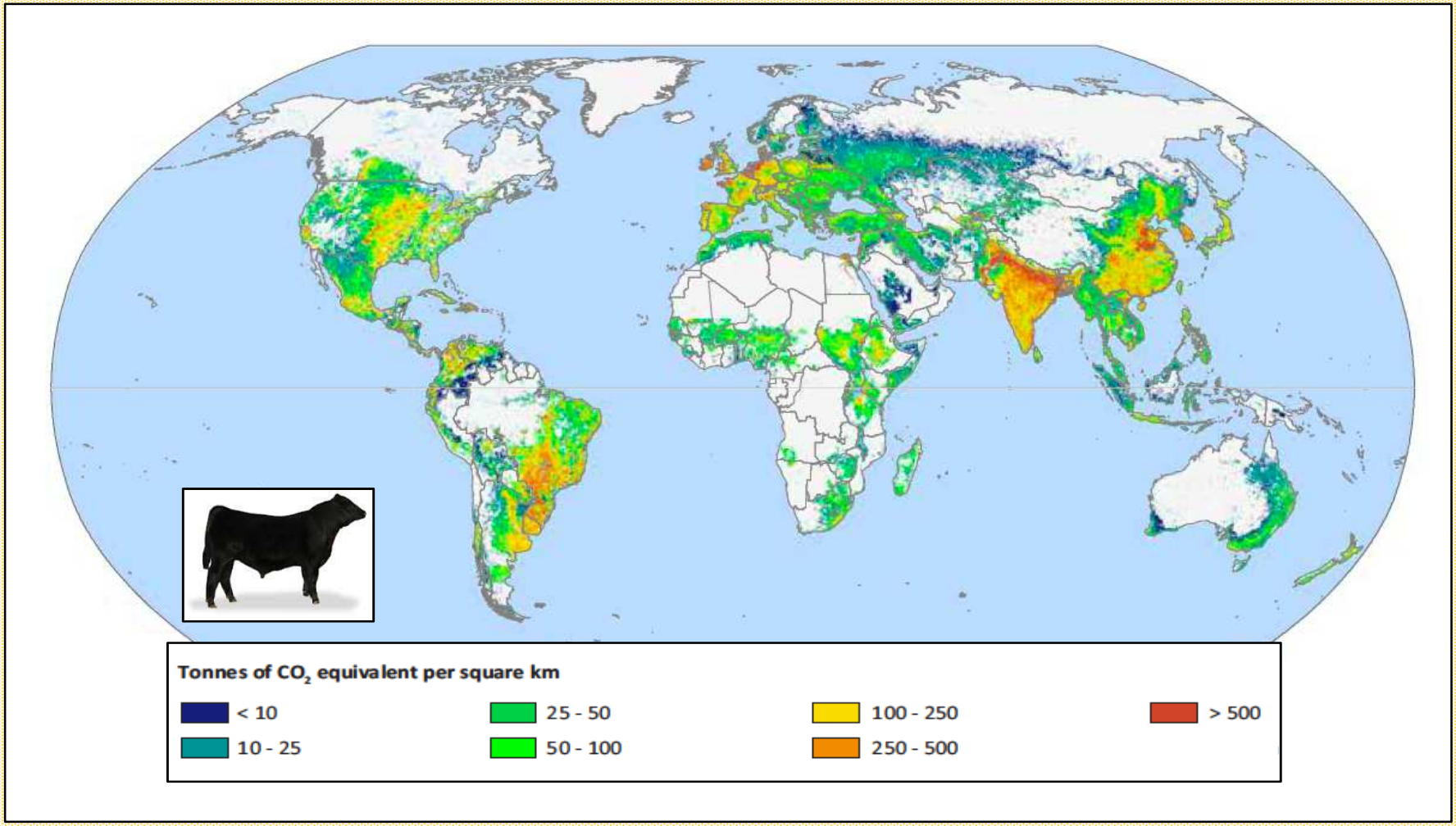
Land-use change (deforestation/de-vegetation)**, livestock production and crop activities explain GHG emissions in the rural sector**

Together with central Africa and South Asia, the ABPU region is considered one of the largest GHG emitters. ABPU amounts 17 % of global GHG emissions attributed to deforestation and de-vegetation.



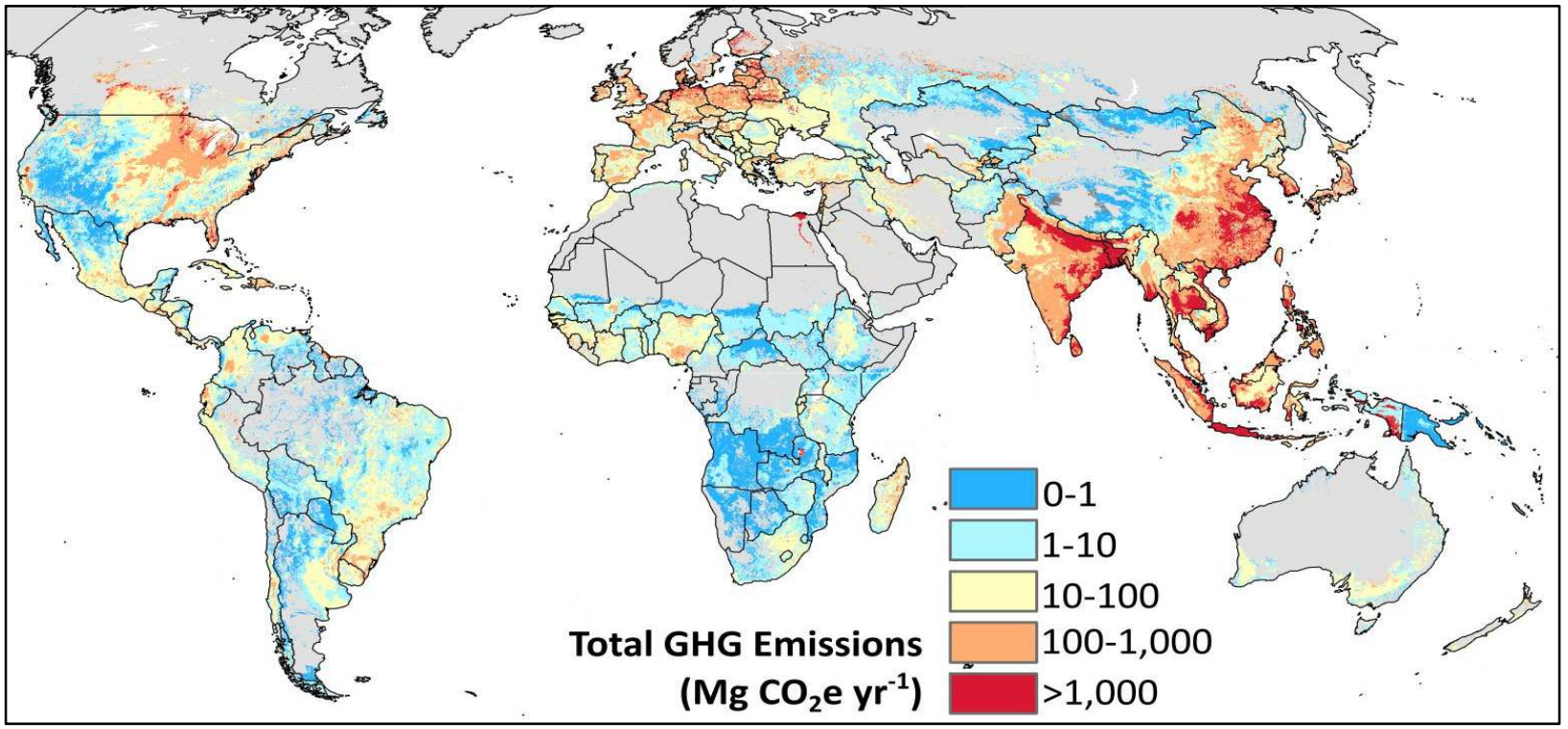
Major hotspots of gross GHG emissions in the world from land-use change during the period 2000-2005. ***Sources: Cuesta et al. (2016); FAOSTAT (2016).***

ABPU amounts 23 % of global GHG emissions attributed to cattle production



Hotspots of global emissions from cattle production. ***Sources: Gerber et al. (2013); FAOSTAT (2016).***

ABPU amounts approximately 12 % of global GHG emissions attributed to crop production.



Distribution and intensity of greenhouse gas released from cropping activity. Estimated global emissions from crop production for 172 crops.

Sources: Carlson et al. (2016); FAOSTAT (2016).

looking ahead

How to avoid suitable solutions to face the wrong problem

The water and carbon footprint of exported food from the ABPU region is negligible in global terms

Water footprint of the global rural sector
8 306 290 000 km³/year
(100 %)

Water footprint of ABPU rural sector
696 520 000 km³/year
(8.39 %)

Water footprint of ABPU exported food
116 780 000 km³/year
(1.07 %)

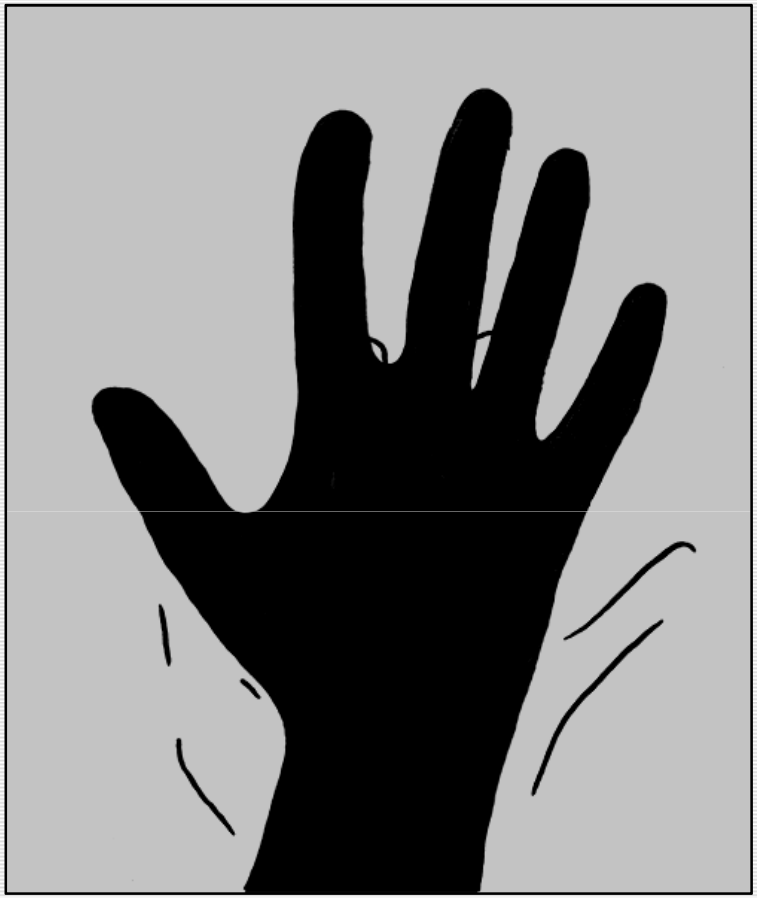
Carbon footprint of the global rural sector
4 674 042 000 ton eq-CO_2/year
(100 %)

Carbon footprint of ABPU rural sector
1 067 168 000 ton eq-CO_2/year
(22,83 %)

Carbon footprint of ABPU exported food
130.180 ton eq-CO_2/year
(0.00028 %)

Incidence of ABPU rural sector on the balance of water and carbon in the total rural sector of the world

Solutions will be elusive if we tackle the problem by the wrong side



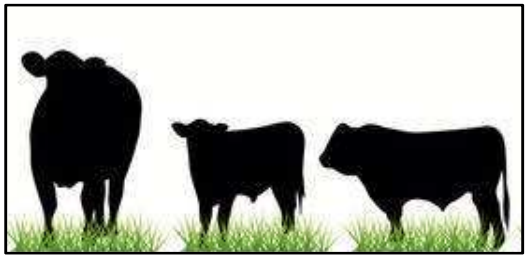
Our problem is not water nor carbon footprint. Neither water scarcity at a regional level. Our problem is how to effectively reduce GHG emissions of the rural sector in an integrated region.

Three are the sources of GHG emission in the ABPU rural sector. What to do?

Deforestation

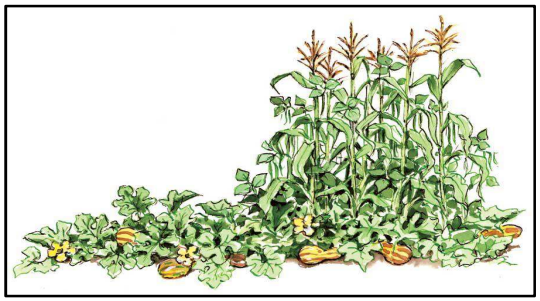
16 %

Cattle production



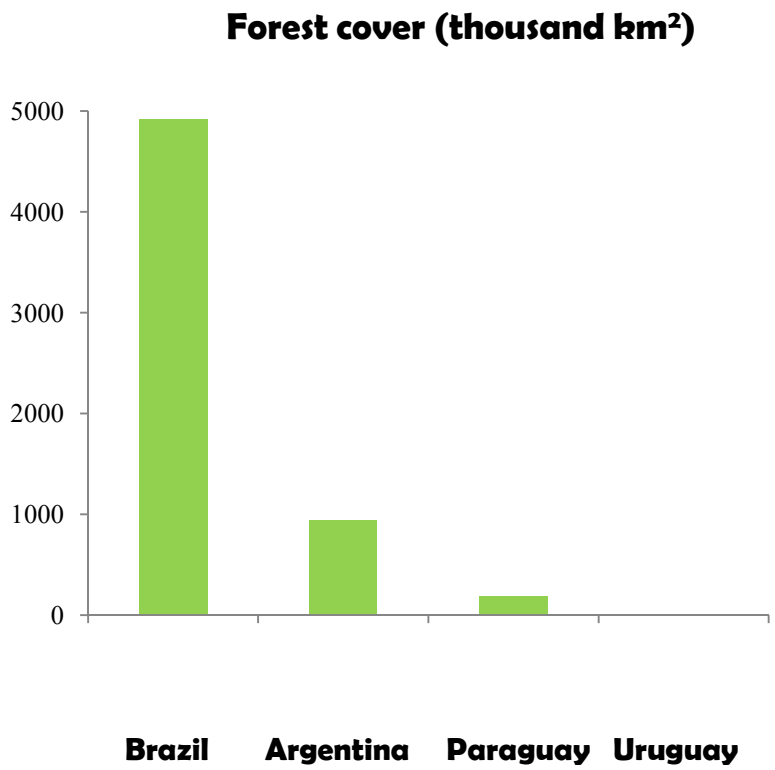
23 %

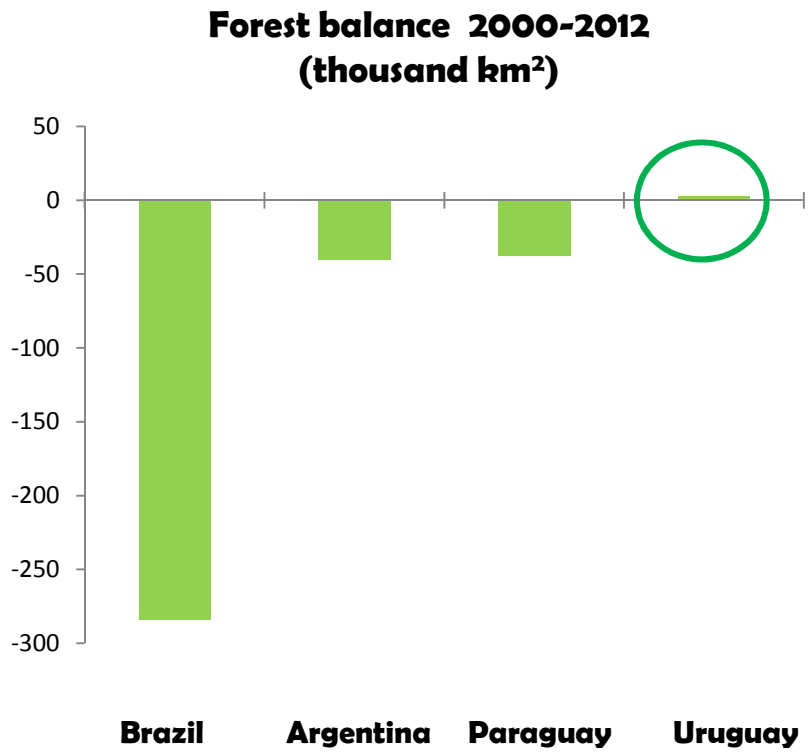
Crop production



12 %

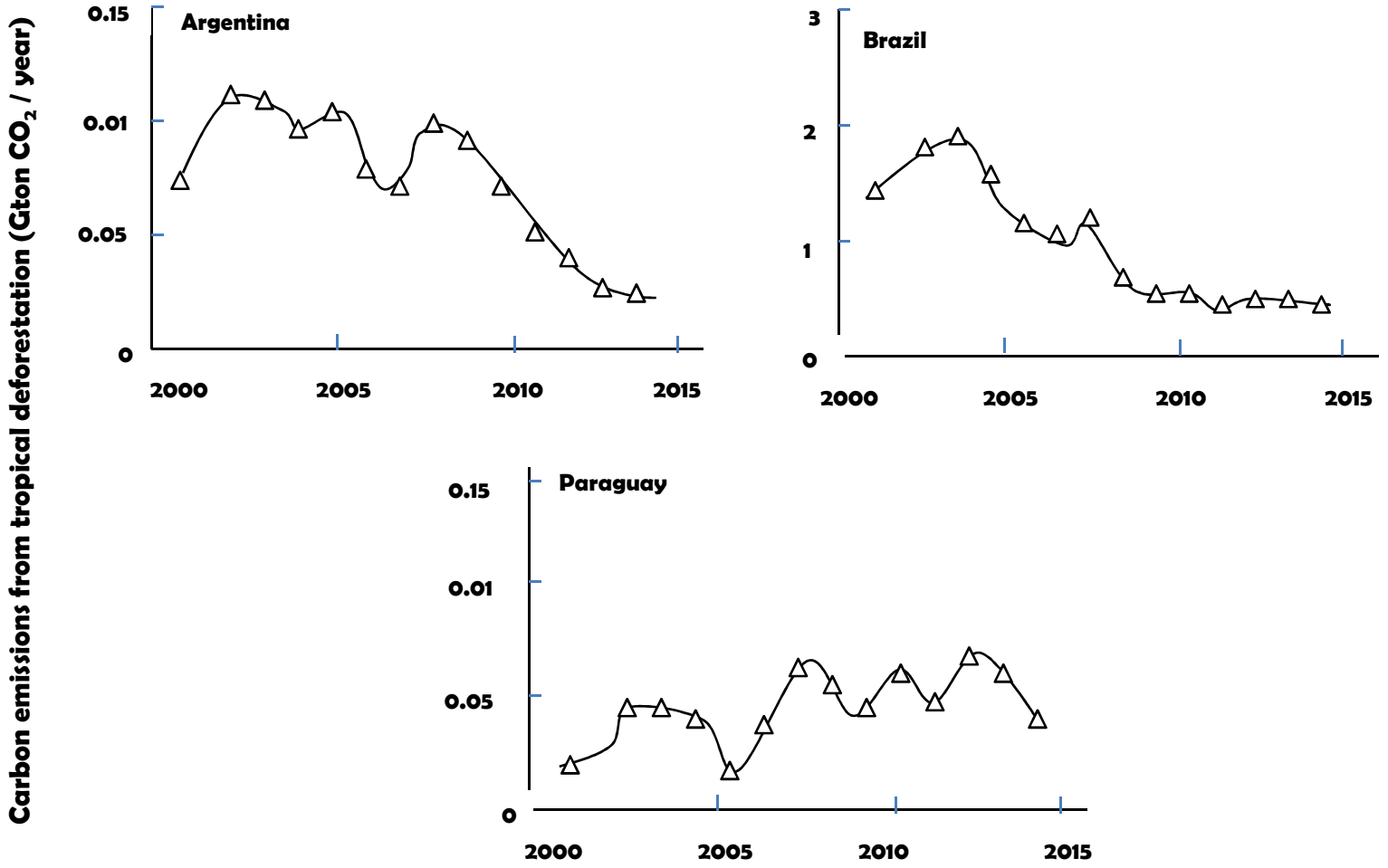
Only Uruguay shows forest gain in the ABPU region, however...





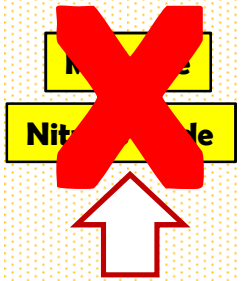
Relative weight of forests and forest loss and gain in the ABPU region.
Source: Jones et al. (2016).

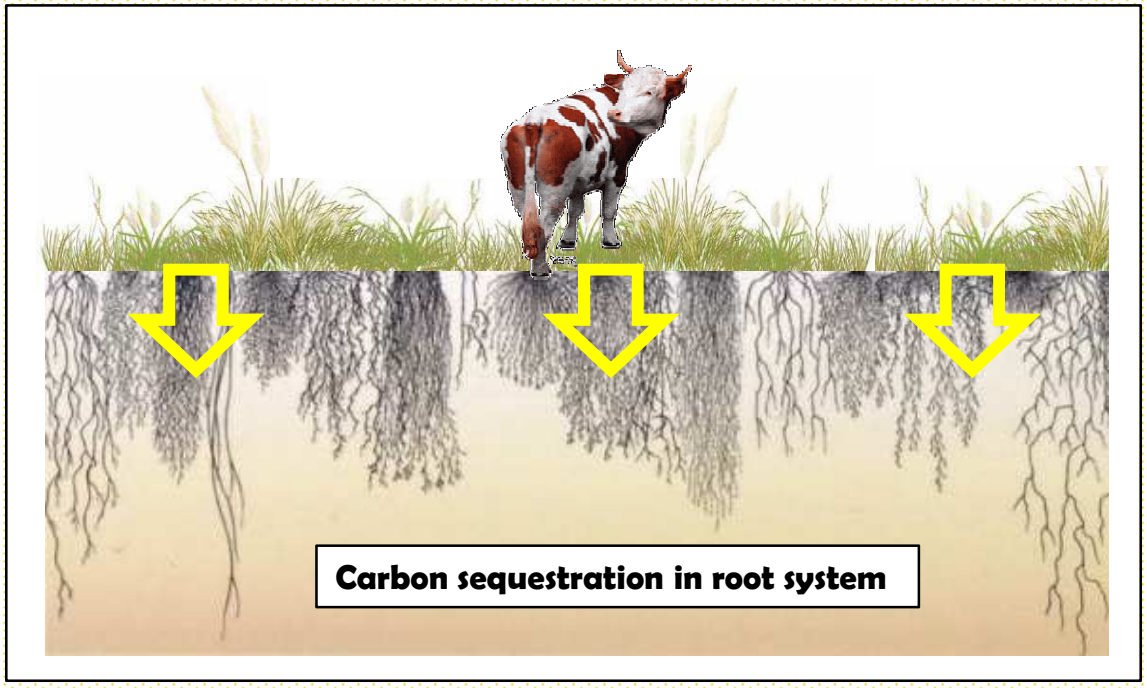
...the ABPU region, as a whole, shows a declining deforestation trend



Carbon emissions from deforestation ***(Source: World Bank, 2012; Zarin et al., 2016).***

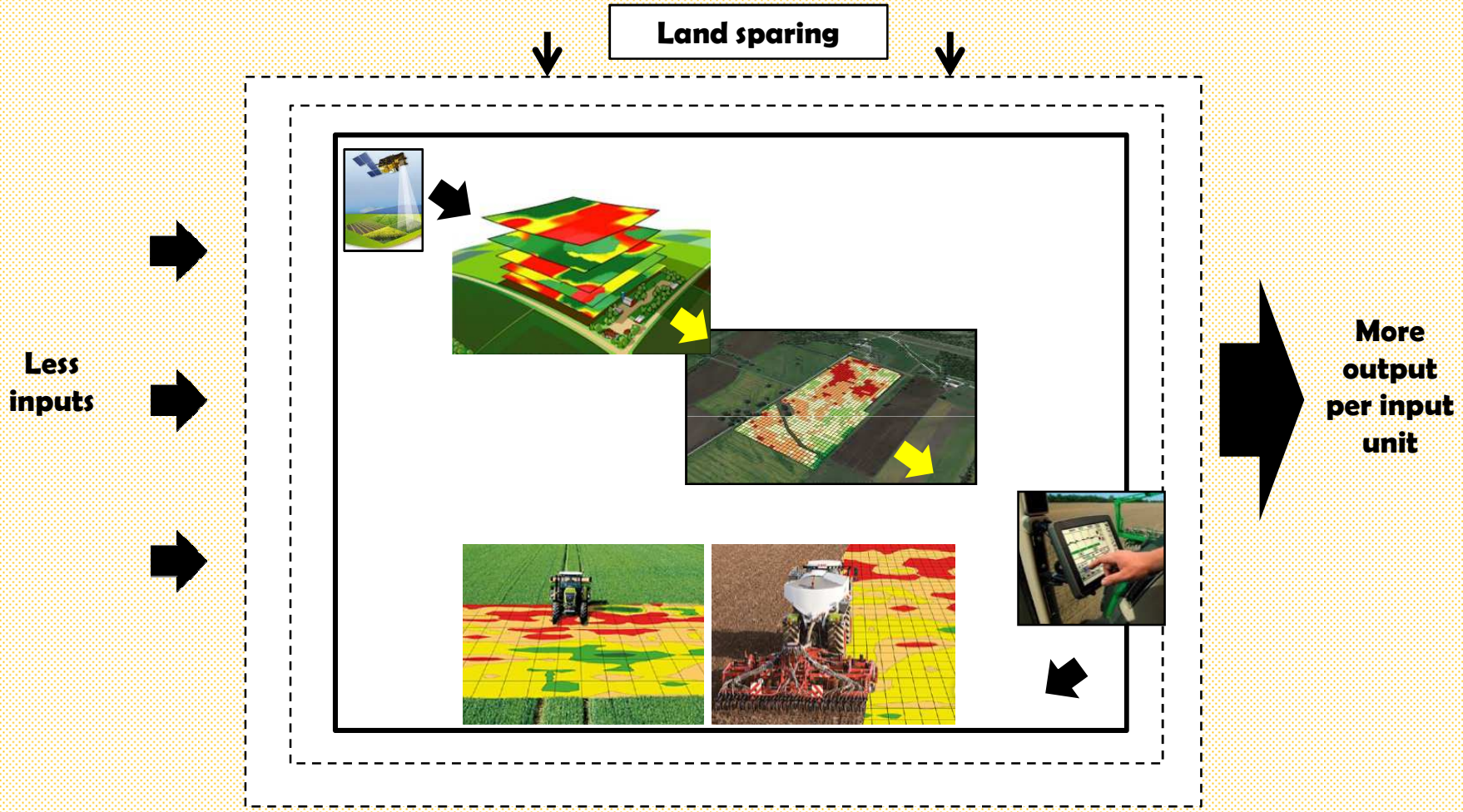
Enteric emissions are difficult to avoid because they are a metabolic attribute of ruminants. And common sense indicates that cattle can not be removed from ABPU fields because of social and economic reasons





...however, there is much room to improve the carbon balance in grazing lands by boosting carbon sequestration in the root system of grasslands and savannas

"High-tech, precision farming" is a promising way to save inputs and reduce carbon emissions in crop production and spare land for carbon sequestration



i) release cropland and grazing lands to conservation by increasing land productivity; ii) adopt minimum- and no till systems; iii) increase the efficient use of agricultural inputs (oil, fertilizers, pesticides) that demand fossil fuel for manufacturing; iv) minimize water use by increasing irrigation efficiency.

Concluding remarks for the ABPU food strategy

Because of the large availability of land and renewable freshwater, the ABPU region plays –and will play- an increasing strategic role in the global food security and the provision of virtual water to water-scarce countries.

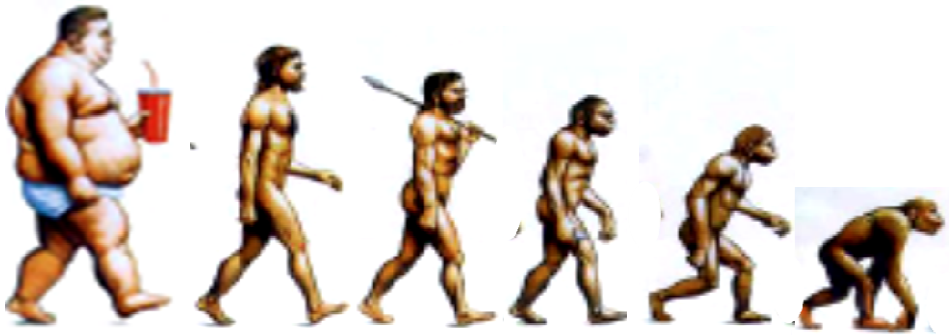
Fair trade and open markets are the ways to provide food and water security to food-demanding countries.

Markets undeniably command and rule..! However the use of water/carbon footprint as potential trade barrier for food export lacks scientific consistency.

The water embedded in food and the carbon released throughout the food chain is fully irrelevant in relative terms, and have no impact on the global balance of water and carbon.

Problems related to carbon emission and water use in the rural sector should be resolved on broad-scale basis, avoiding the reductionist footprint view.

Happy back home...!



Thank you ...!

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