Water footprint of beef production – critical review of current approaches

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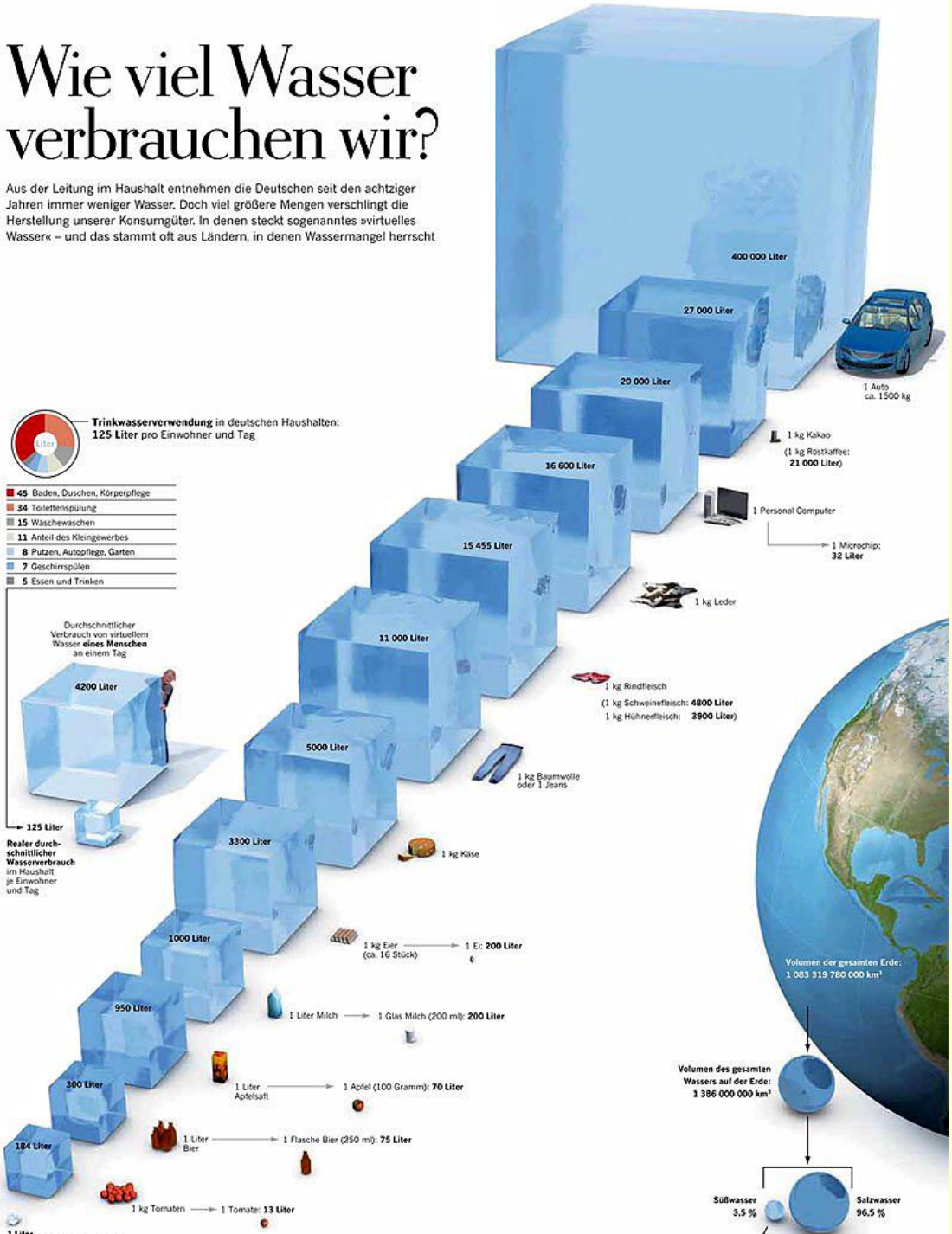
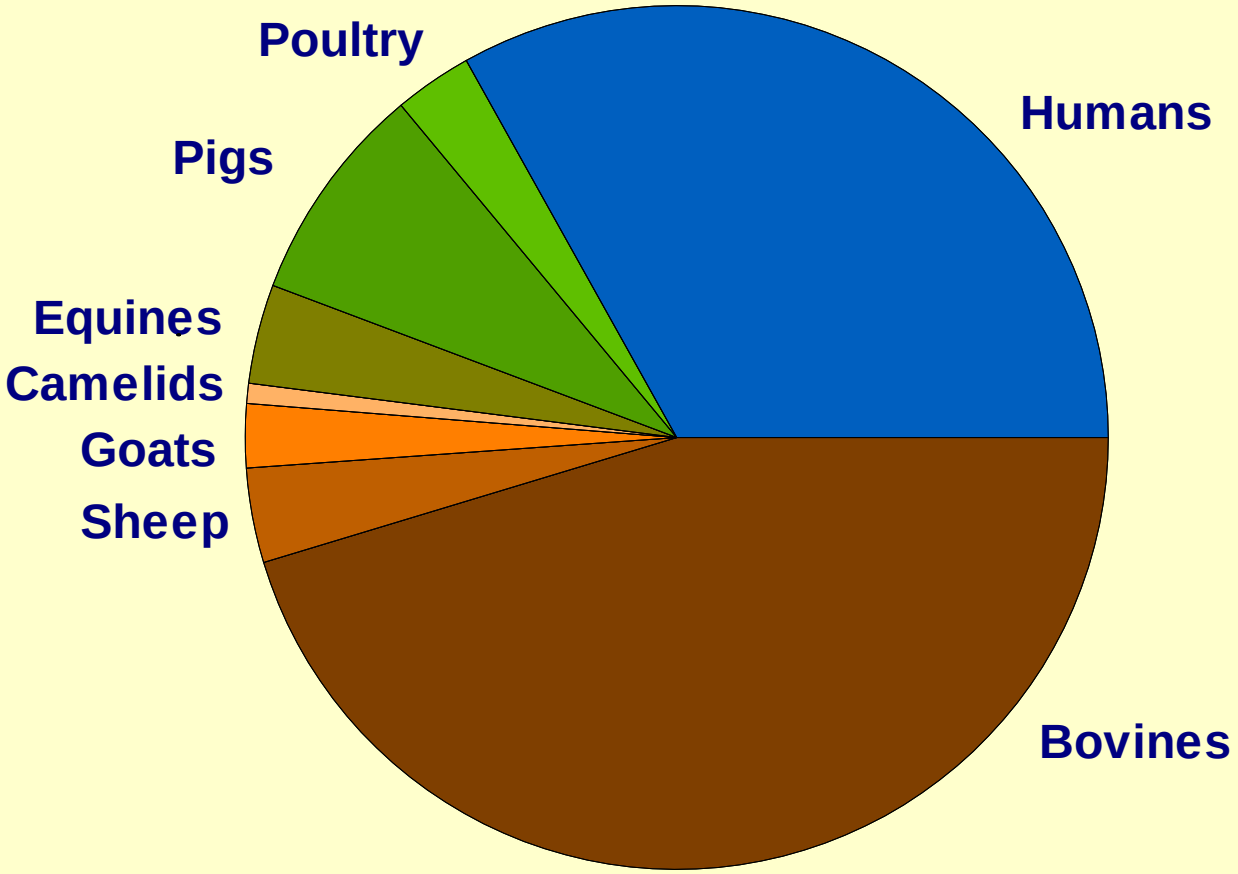
Wie viel Wasser verbrauchen wir?

Aus der Leitung im Haushalt entnehmen die Deutschen seit den achtziger Jahren immer weniger Wasser. Doch viel größere Mengen verschlingt die Herstellung unserer Konsumgüter. In denen steckt sogenanntes »virtuelles Wasser« – und das stammt oft aus Ländern, in denen Wassermangel herrscht



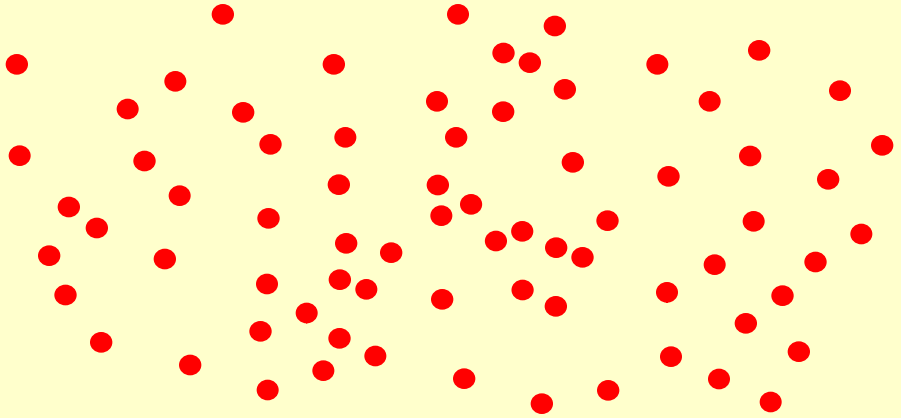
Comparative global biomass of humans and the major livestock groups



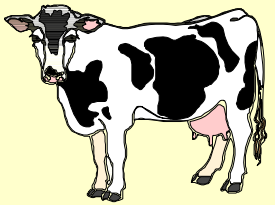
Data Source: FAO 2008 and author's calculations

Why do we keep cattle?

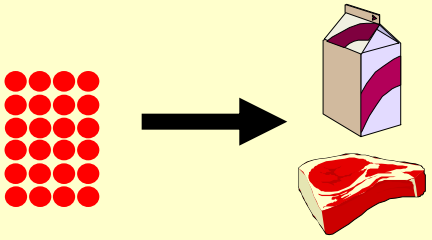
Large quantity but
low density of nutrients in
natural and agricultural
ecosystems



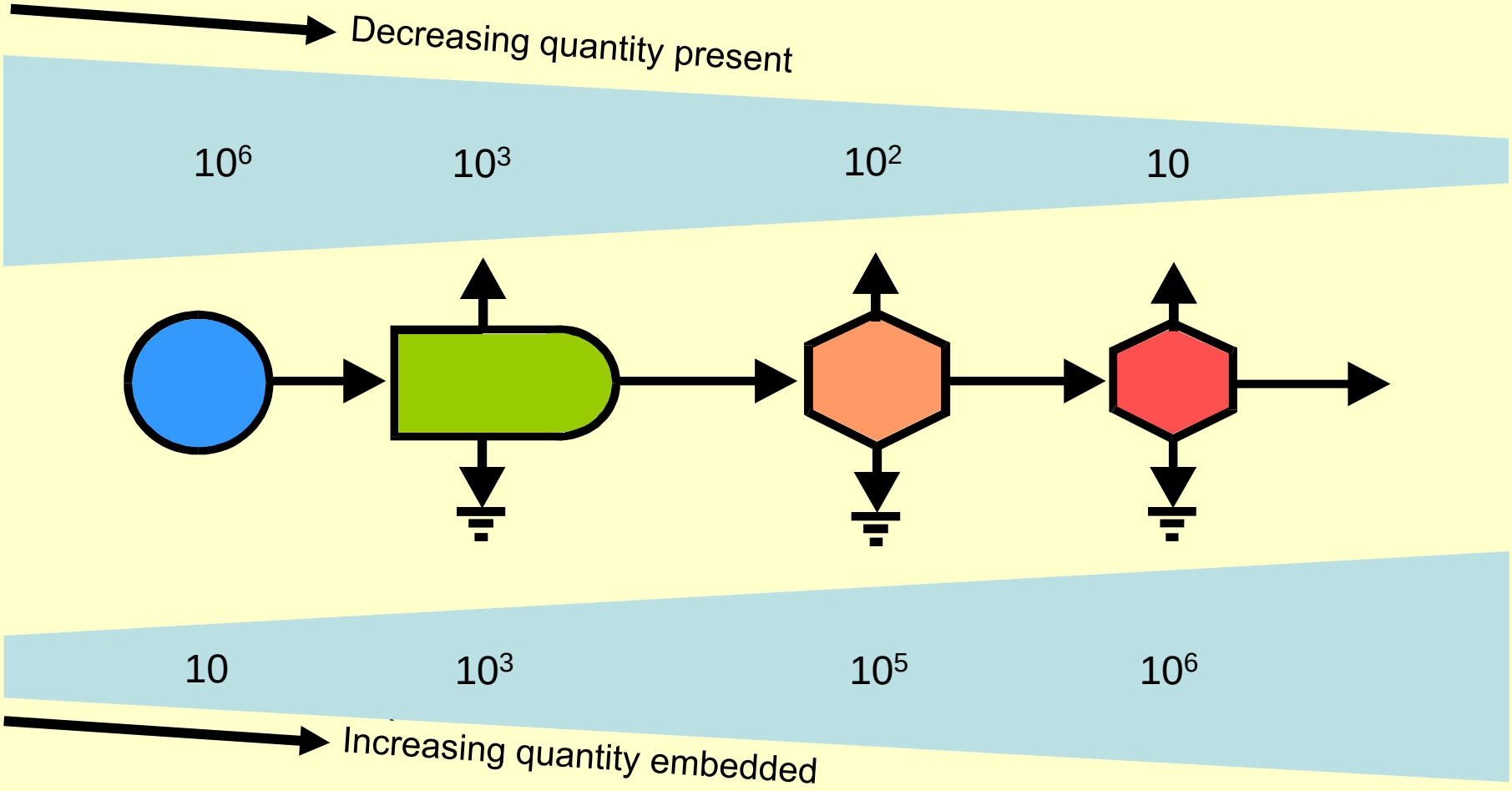
collected by cattle
and converted into



small quantity of high nutrient
density human food



Increasing embedded (virtual) water accompanies decreasing water content in food chains



Virtual water content of various feeds, forages, and of boneless beef [m³ / kg DM]

[1)] authors data; [2)] various literature sources

Feed type	Virtual water content [2)] [m³ / kg DM]	Blue water use
Alfalfa	5.8 - 9.0	+++
Forage sorghum	1.2 - 1.6	++
Soybeans (grain)	1.5 - 4.1	+
Wheat (grain)	0.69 - 2.3	(+)
Maize (grain)	0.4 - 1.9	(+)
Pennisetum p.	2.3 - 4.3	-
Temperate grasslands [1)]	0.8 - 1.5	-
Dry tropical grasslands[1)]	1.7 - 2.2	-
Poultry meat	2.3 - 5.7	
Pork	2.9 - 6.9	
Boneless beef	10.0 - 100.0	

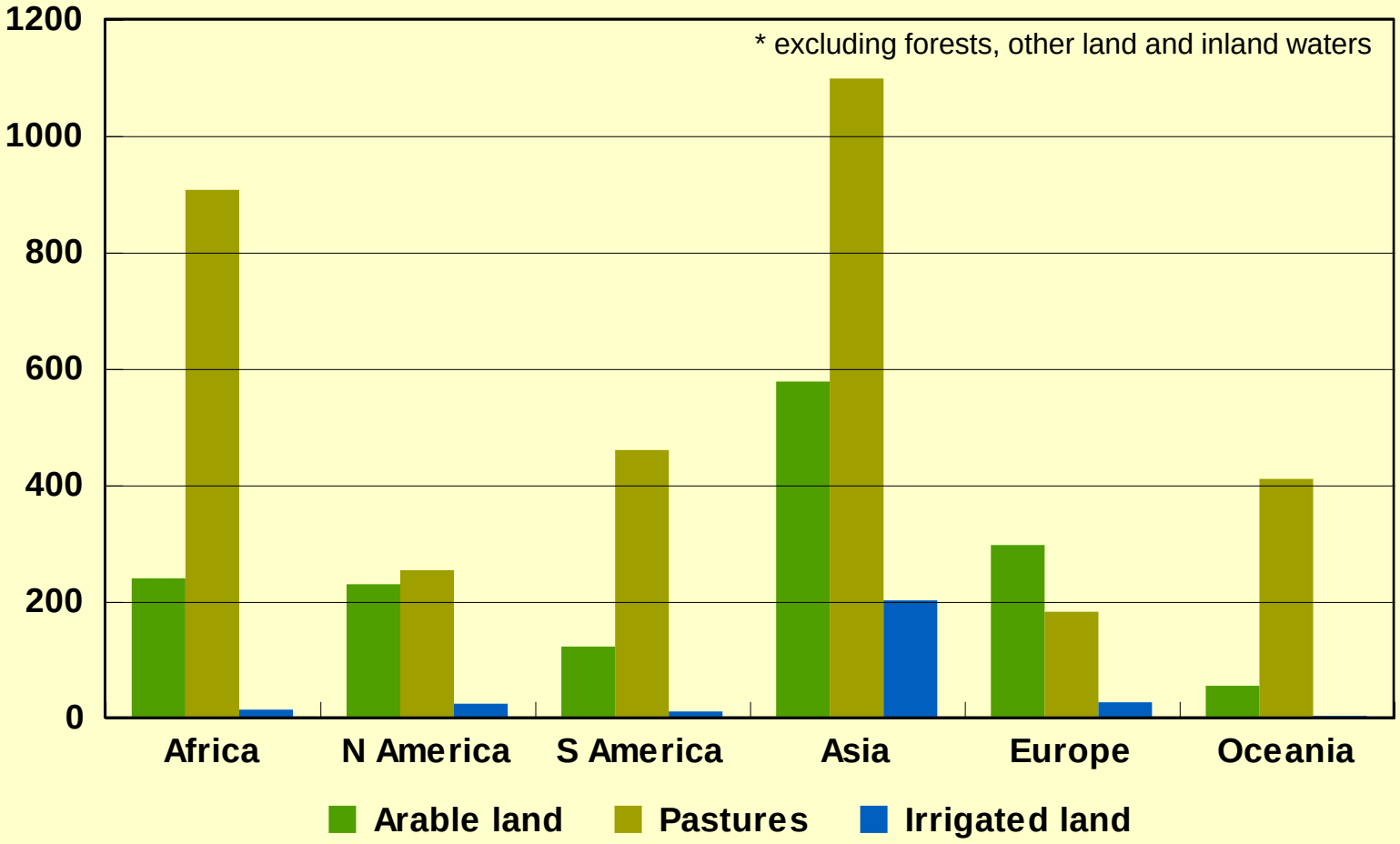
Main characteristics of BLUE and GREEN water

Type / Descriptor	Blue Water	Green Water
Sources	Surface water, accessible aquifers	Stored in unsaturated soils
Mobility	Highly mobile	Immobile
Alternative uses	Many competing	None
Opportunity costs	High to very high	Medium to zero
Major agricultural use	Crop irrigation, livestock drinking, processing, and management	Rainfed crop production, natural and derived pastures, plant transpiration

Water demand of beef production

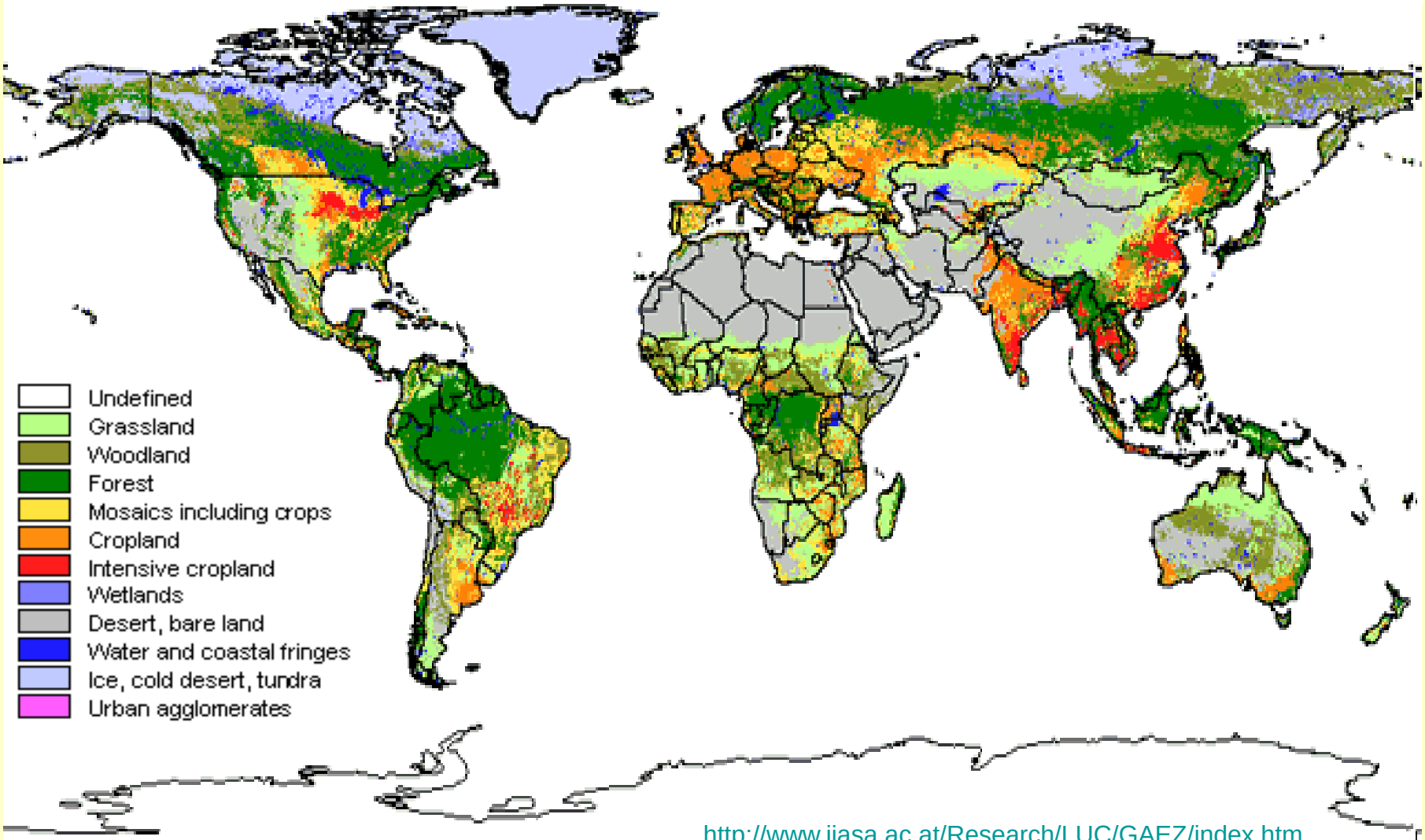
Demand category	Source	Amount	Data quality
Drinking water	Blue water	10 - 20 % live wt/day	measurable, well researched
Water for service and management	Blue water	negligible	measurable
Water for processing	Blue water	negligible	measurable
Water for feed production	**Green water**	10 - 100 m^3/ kg boneless beef	assumption based, modelled

Regional distribution of arable land, permanent pastures and irrigated land [million ha]*



Data Source: http://faostat.fao.org/site/377/

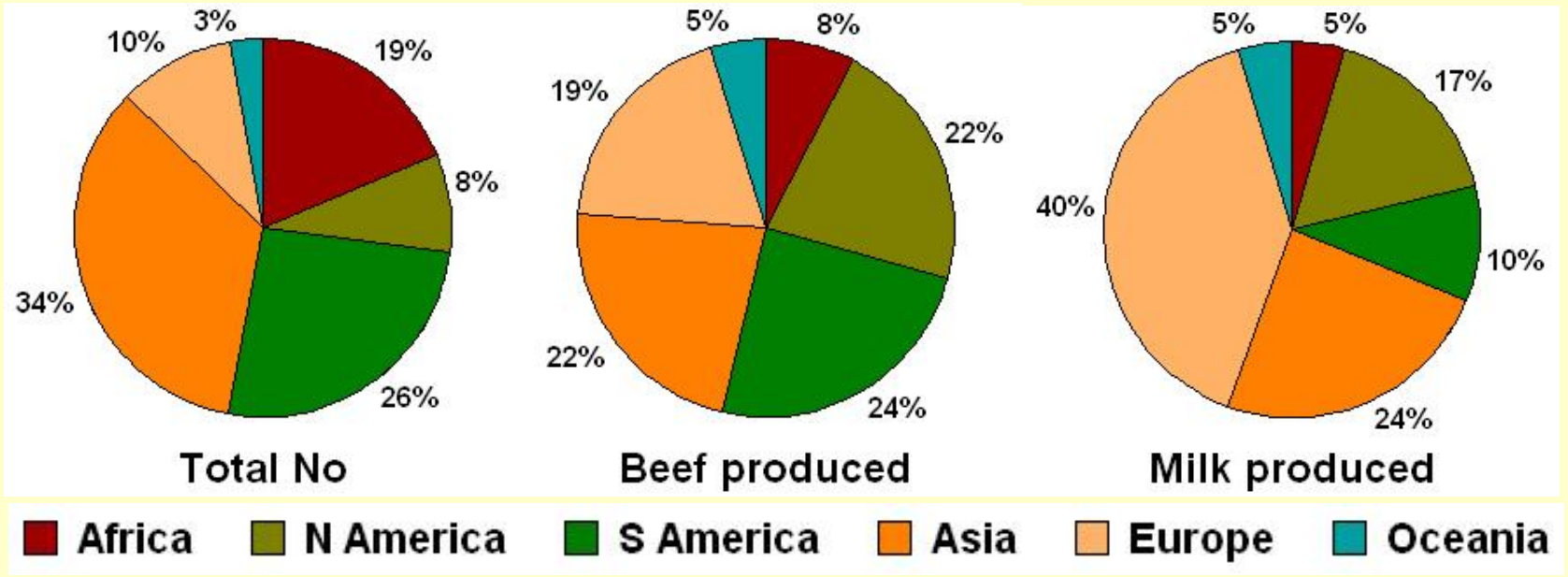
Dominant ecosystem classes



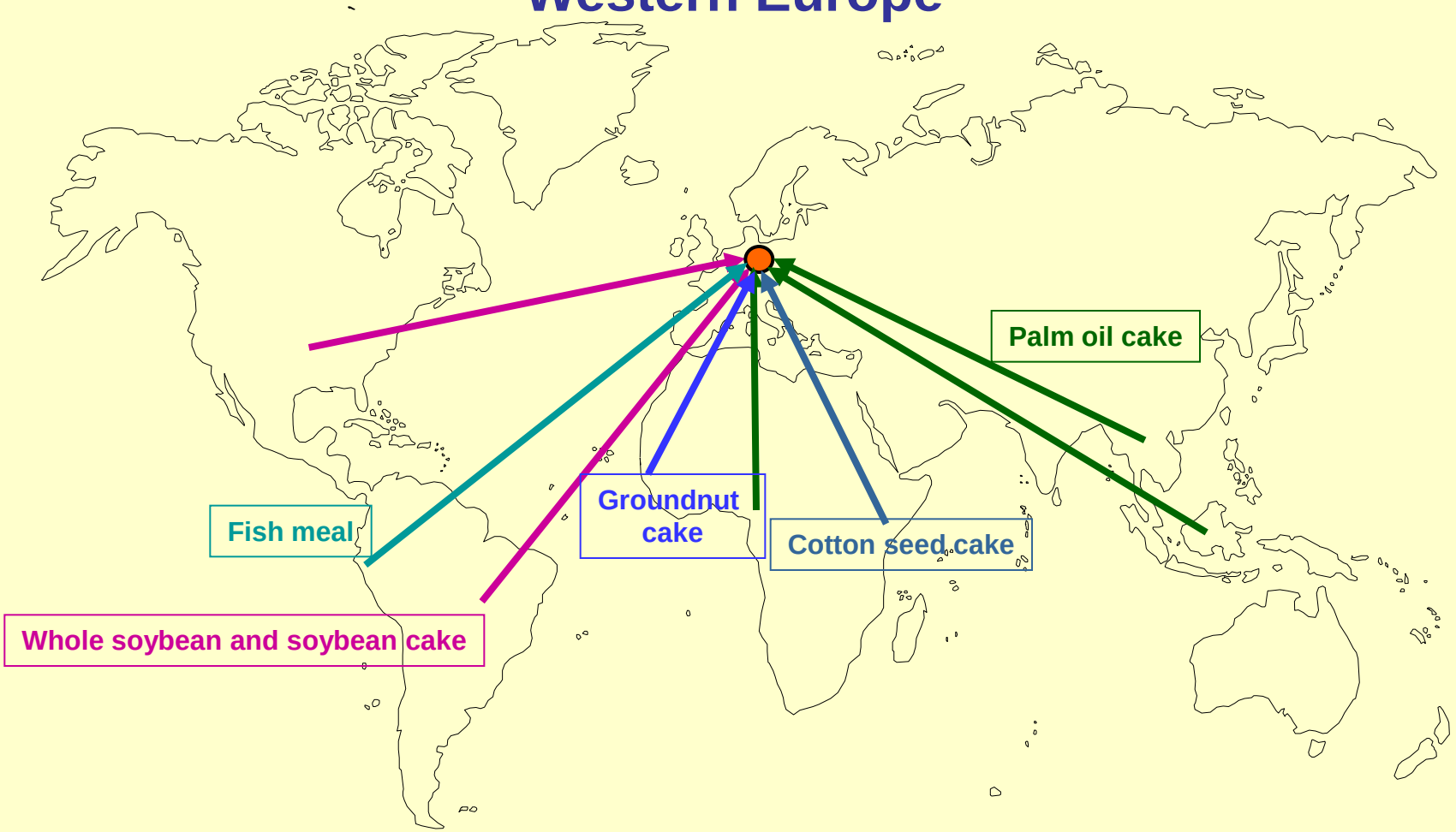
http://www.iiasa.ac.at/Research/LUC/GAEZ/index.htm

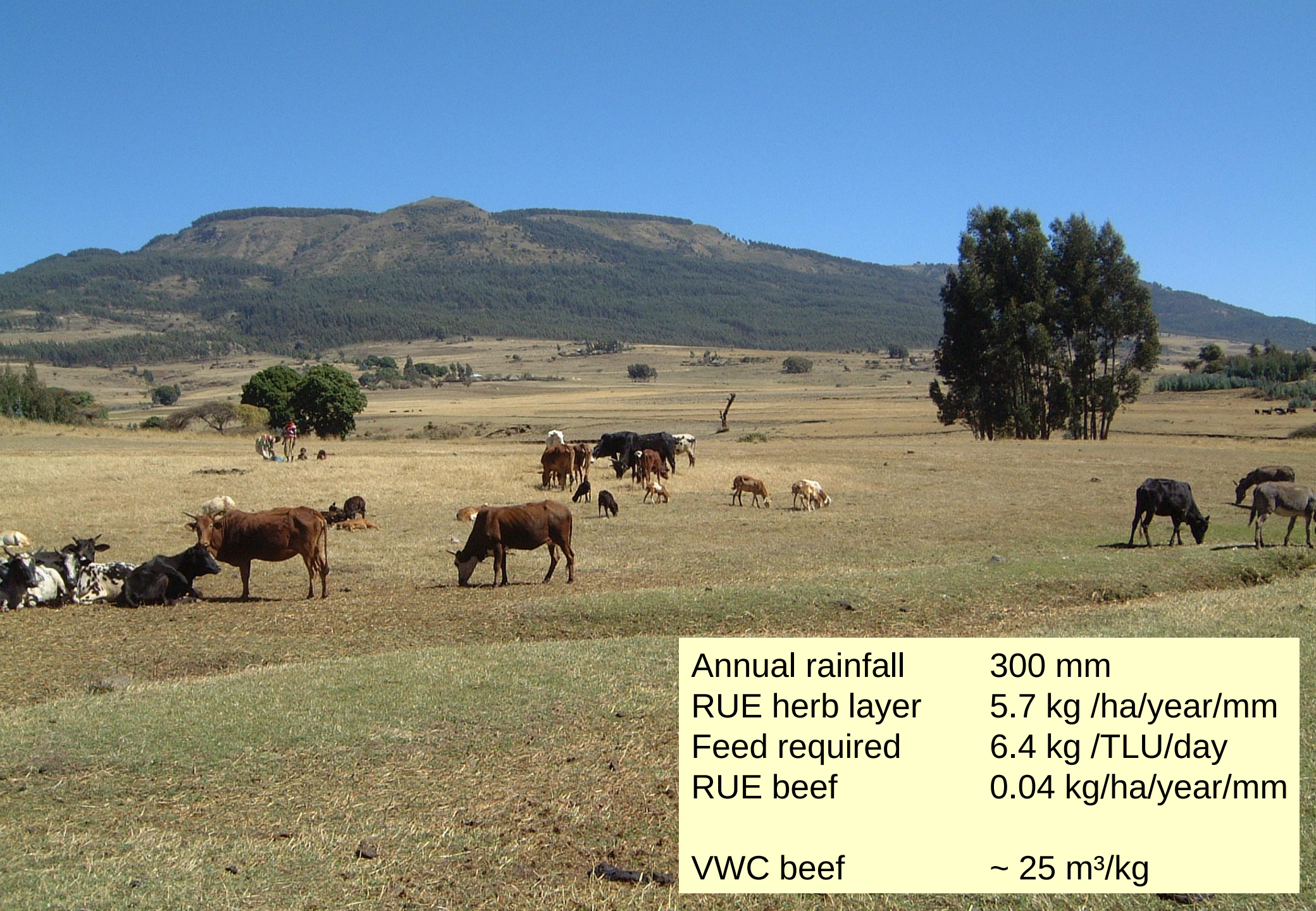
Cattle numbers, beef and milk production as percent of world totals in 2005

Source: http://faostat.fao.org/site/569/



Material transports connected to beef production in Western Europe





Annual rainfall	300 mm
RUE herb layer	5.7 kg /ha/year/mm
Feed required	6.4 kg /TLU/day
RUE beef	0.04 kg/ha/year/mm
VWC beef	~ 25 m^3/kg

Conclusions

Beef production based on pastures, crop residues and crop processing by-products incurs no or very limited water costs

Virtual water content calculations of beef need to be re-examined in this light

Grain based beef production systems can reduce water costs by replacing whole grain with higher proportions of crop residues and agricultural by-products


Thank you for your attention