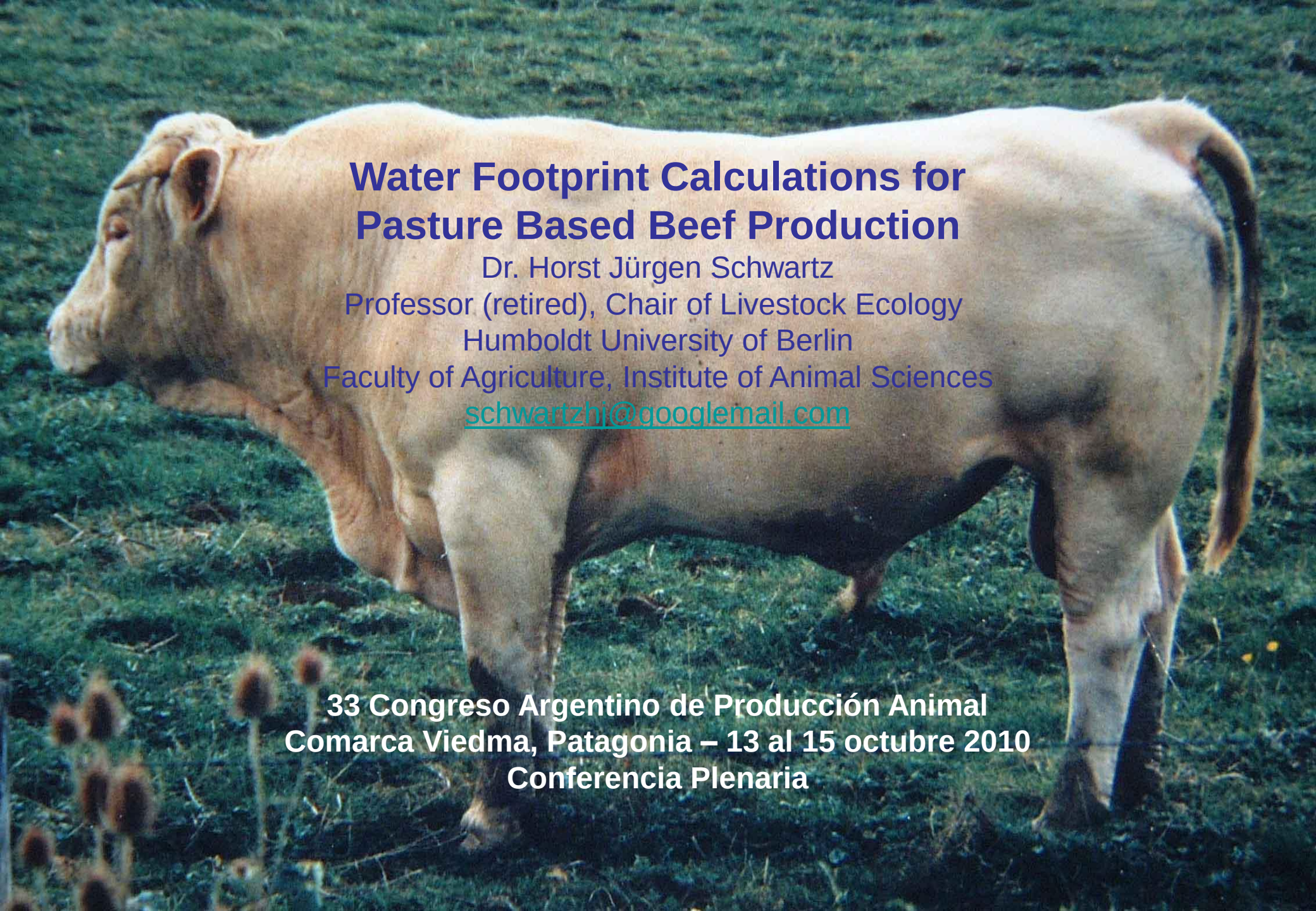

Water Footprint Calculations for Pasture Based Beef Production

Dr. Horst Jürgen Schwartz
Professor (retired), Chair of Livestock Ecology
Humboldt University of Berlin
Faculty of Agriculture, Institute of Animal Sciences
schwartzhj@googlemail.com

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Conferencia Plenaria

Water Footprint

Water Footprint NETWORK

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People use lots of water for drinking, cooking and washing, but even more for producing things such as food, paper, cotton clothes, etc. The water footprint is an indicator of water use that looks at both direct and indirect water use of a consumer or producer. The water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business.

16000 litres water

1 kg beef

The relation between consumption and water use

"The interest in the water footprint is rooted in the recognition that human impacts on freshwater systems can ultimately be linked to human consumption, and that issues like water shortages and pollution can be better understood and addressed by considering production and supply chains as a whole," says Professor Arjen Y. Hoekstra, creator of the water footprint concept and scientific director of the Water Footprint Network. "Water problems are often closely tied to the structure of the global economy. Many countries have significantly externalised their water footprint, importing water-intensive goods from elsewhere. This puts pressure on the water resources in the exporting regions, where too often mechanisms for wise water governance and conservation are lacking. Not only governments, but also consumers, businesses and civil society communities can play a role in achieving a better management of water resources."

New in 2008: Book on 'Globalisation of Water'

The 2007-paper on 'Water Footprints of Nations'

Water Footprints of Nations

The 2008-paper on 'Water Neutrality'

Water Neutral

Download other publications

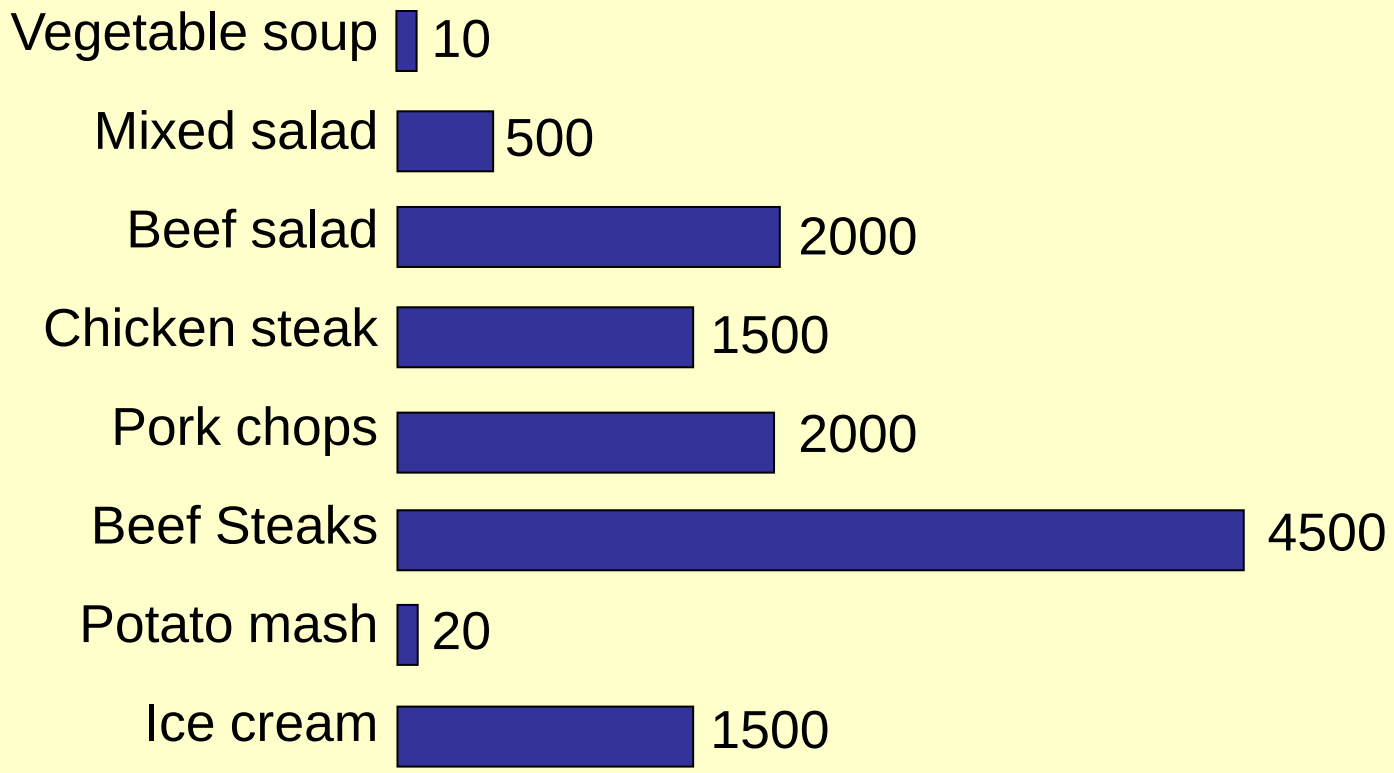
List of publications

Some facts and figures

Global average water footprint of beef

- **15.5 m^3 of water per 1 kg of beef.**
- **In an industrial beef production system, it takes 3 years to slaughter and to produce about 200 kg of boneless beef.**
- **The animal consumes nearly 1300 kg of grains (wheat, oats, barley, corn, dry peas, soybean meal and other small grains),**
- **7200 kg of roughages (pasture, dry hay, silage and other roughages).**
- **Producing the volume of feed requires about 15.3 m^3 water in average.**
- **24 m^3 water for drinking and 7 m^3 for servicing.**

Water cost of a continental menu [l/dish]



Source: IHE, 3rd World Water Forum, 2003

BBC NEWS WORLD EDITION

Last Updated: Monday, 16 August, 2004, 16:45 GMT 17:45 UK

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Hungry world 'must eat less meat'

By Alex Kirby
BBC News Online environment correspondent

World water supplies will not be enough for our descendants to enjoy the sort of diet the West eats now, experts say.

Livestock needs a lot of water

The World Water Week in Stockholm will be told the growth in demand for meat and dairy products is unsustainable.

Importance of water to livestock

- 90 % of all molecules in the body are water
- approximately 70 % of animal body weight is water, it varies by species and body part
- maintaining water balance is critical for survival, it is closely linked to digestion and thermoregulation

Importance of water to livestock: Example one zebu steer at slaughter weight

(1) Drinking water

- Mean body water turnover of a zebu steer is 140 ml $*$ l^{-1}BWP $*$ d^{-1}
- Body water pool is 65 to 70 % of body weight
- Life time drinking water use at 4 years of age weighing 400 kg is 28 000 kg or 2.8 m^3
- Total drinking water 70 kg per 1 kg live weight

Importance of water to livestock: Example one zebu steer at slaughter weight

(2) Water in feed

- 250 kg water evaporated per 1 kg DM grass produced
- 11 kg of grass eaten per 1 kg body weight gain
- 2.75 m^3 feed water per 1 kg of body weight
- Total feed water use at slaughter weight 1128 m^3 or 2.82 m^3 per kg live weight

Importance of water to livestock: Example one zebu steer at slaughter weight

(3) Water for processing

- Dressing percentage 60 %
- Carcass weight 240 kg
- Total water use at slaughtering 0.5 m^3 per carcass

- 6.18 m^3 feed water per 1 kg of clean, dressed carcass

Comparison of water intake with different grazing patterns of cattle in a tropical environment

Water intake	day	night	day & night
$l * animal^{-1} * d^{-1}$	36.0	22.7	35.5
$l * kg^{-1}$ forage	5.1	4.4	4.9
$ml * kg^{-1}$ BW $* d^{-1}$	100	62	105

A.A.Ayantunde et al., 1999

Comparison of water intake of non-lactating and lactating* cows

(G. Gäbel, 2000)

Water intake	non-lactating	lactating
Drinking	26	51
Water in feed	1	2
Metabolic water	2	3
Total	29	56

*** 12 l milk per cow per day**

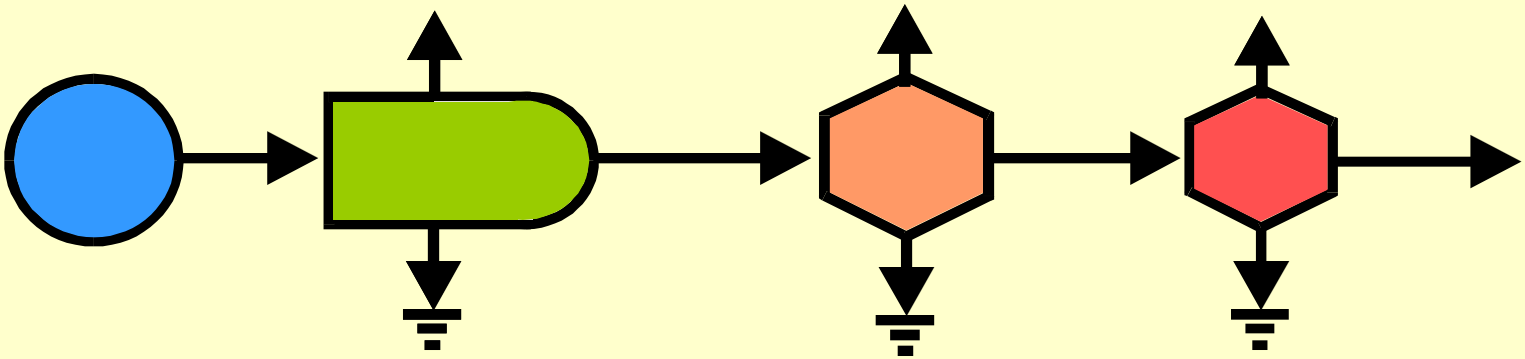
Comparison of water loss in non-lactating and lactating* cows

(G. Gäbel, 2000)

Water loss	non-lactating	lactating
Urine	7	11
Evaporation	10	14
Faeces	12	19
Milk	0	12
Total	29	56

*** 12 l milk per cow per day**

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



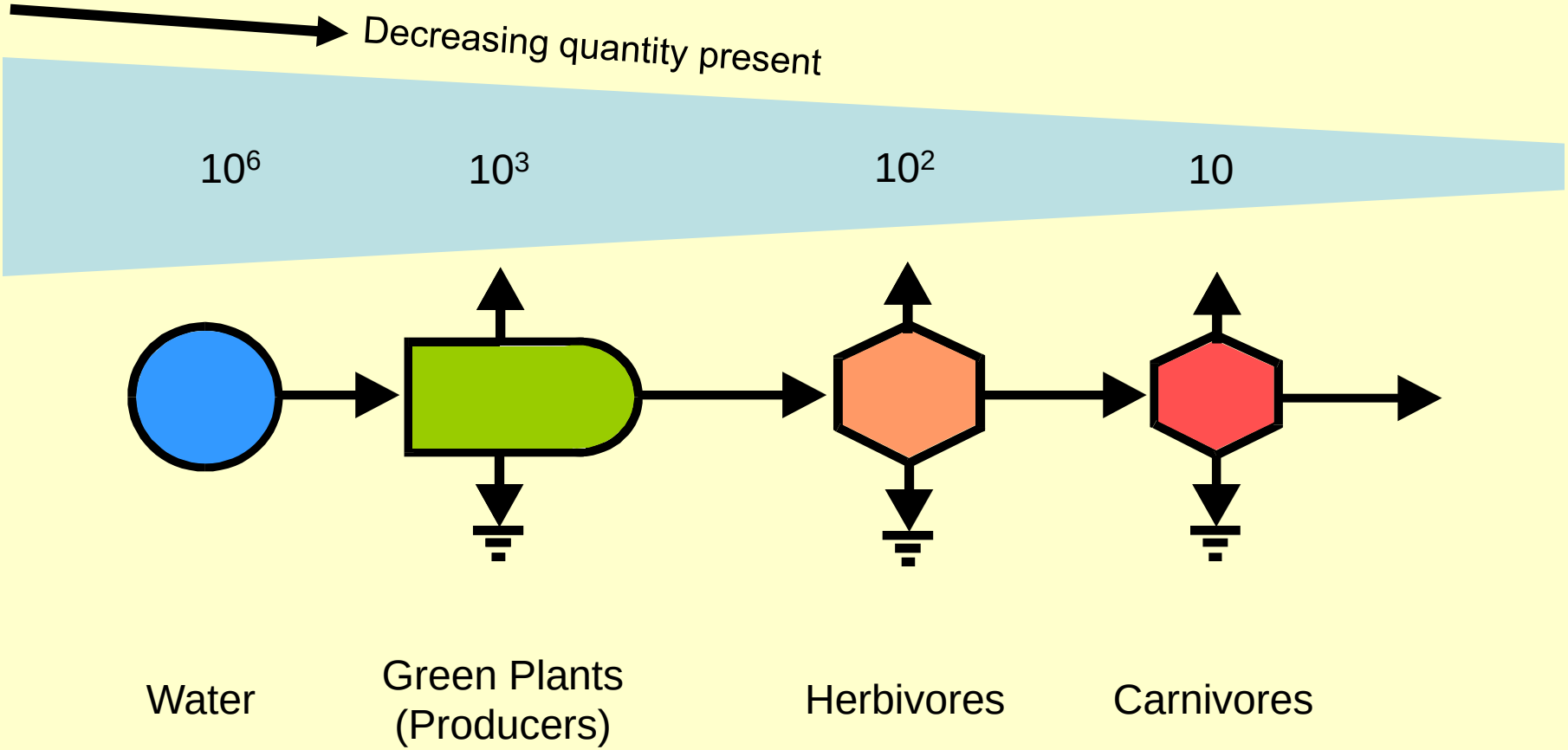
Water

Green Plants
(Producers)

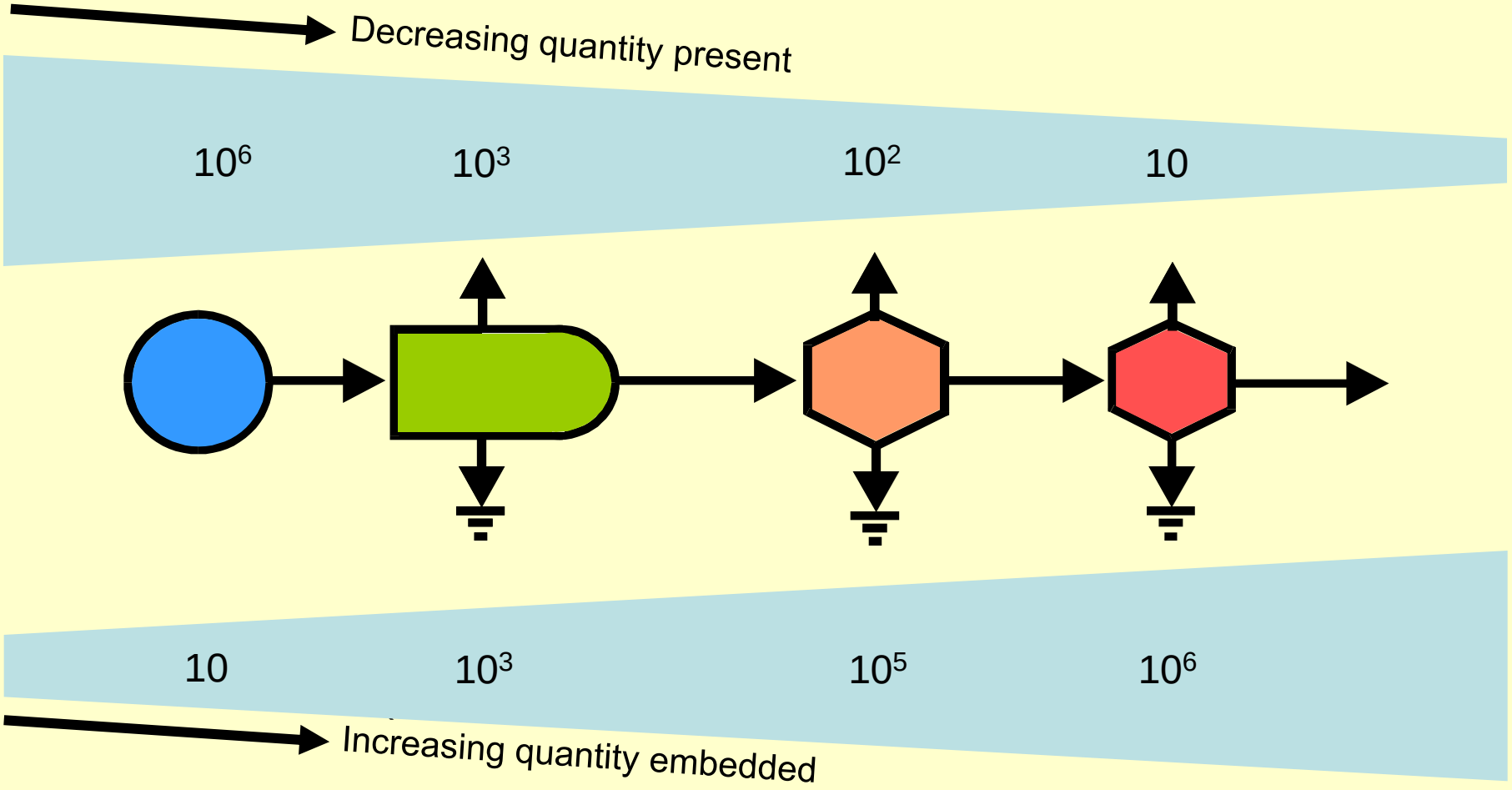
Herbivores

Carnivores

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



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

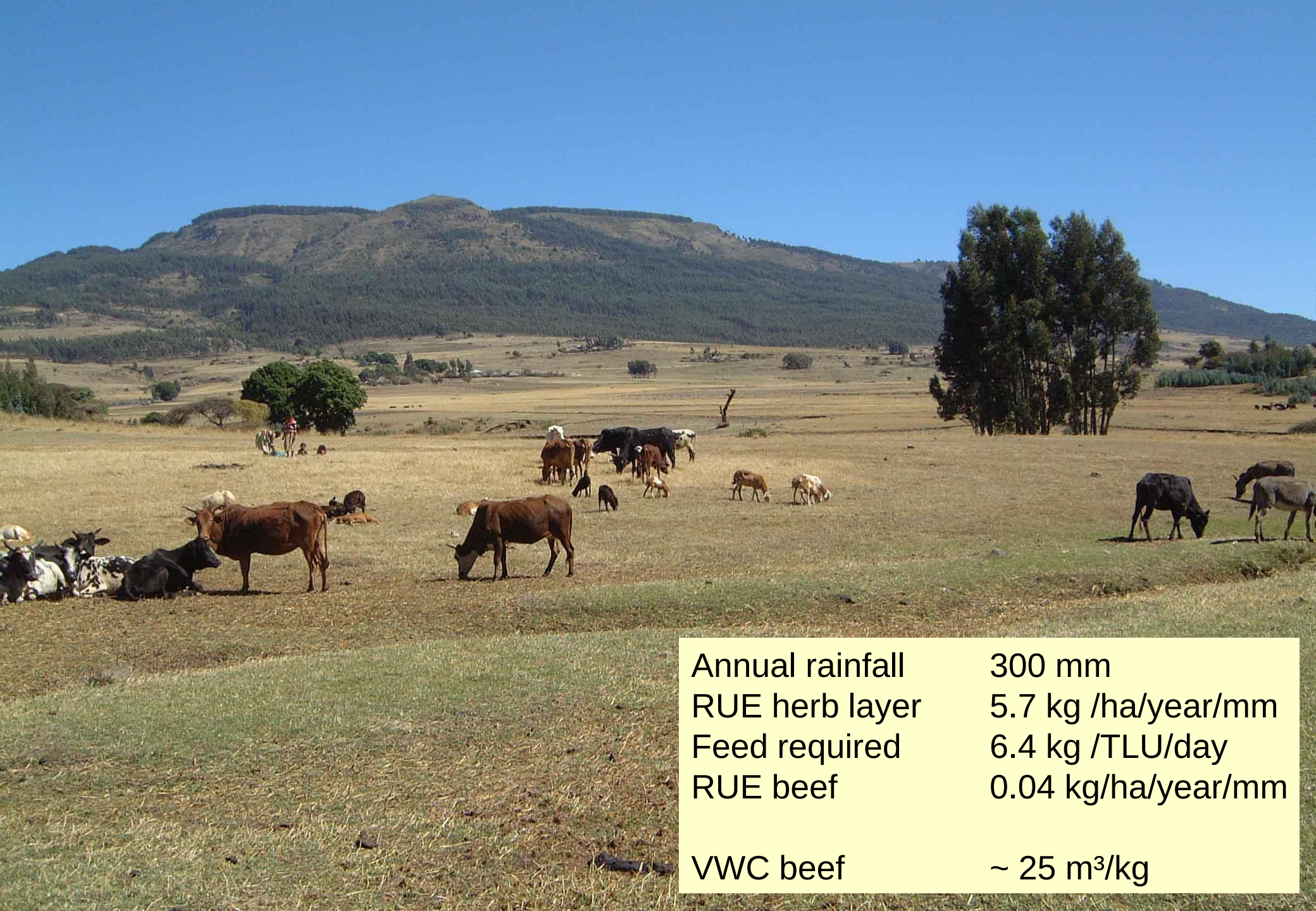


Estimated water volume [litre/ha/year] at different trophic levels in pastoral beef production

(* at the end of the growing season)

Pasture type	**mean annual precipitation**	**water in standing herbaceous biomass***	**water in beef produced**
Semi-arid tropical native pasture East Africa [1]	~ 3×10^6	~ 1.5×10^3	~ 0.4×10^2
Humid sub-tropical native pasture Argentina [2]	~ 11×10^6	~ 4.8×10^3	~ 0.7×10^2
Temperate extensive pasture Germany [3]	~ 5.5×10^6	~ 3.7×10^3	~ 1.1×10^2

Data sources: [1] Schwartz and Walsh (1994), [2] Feldkamp (2004) [3] Schwartz, unpubl.



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

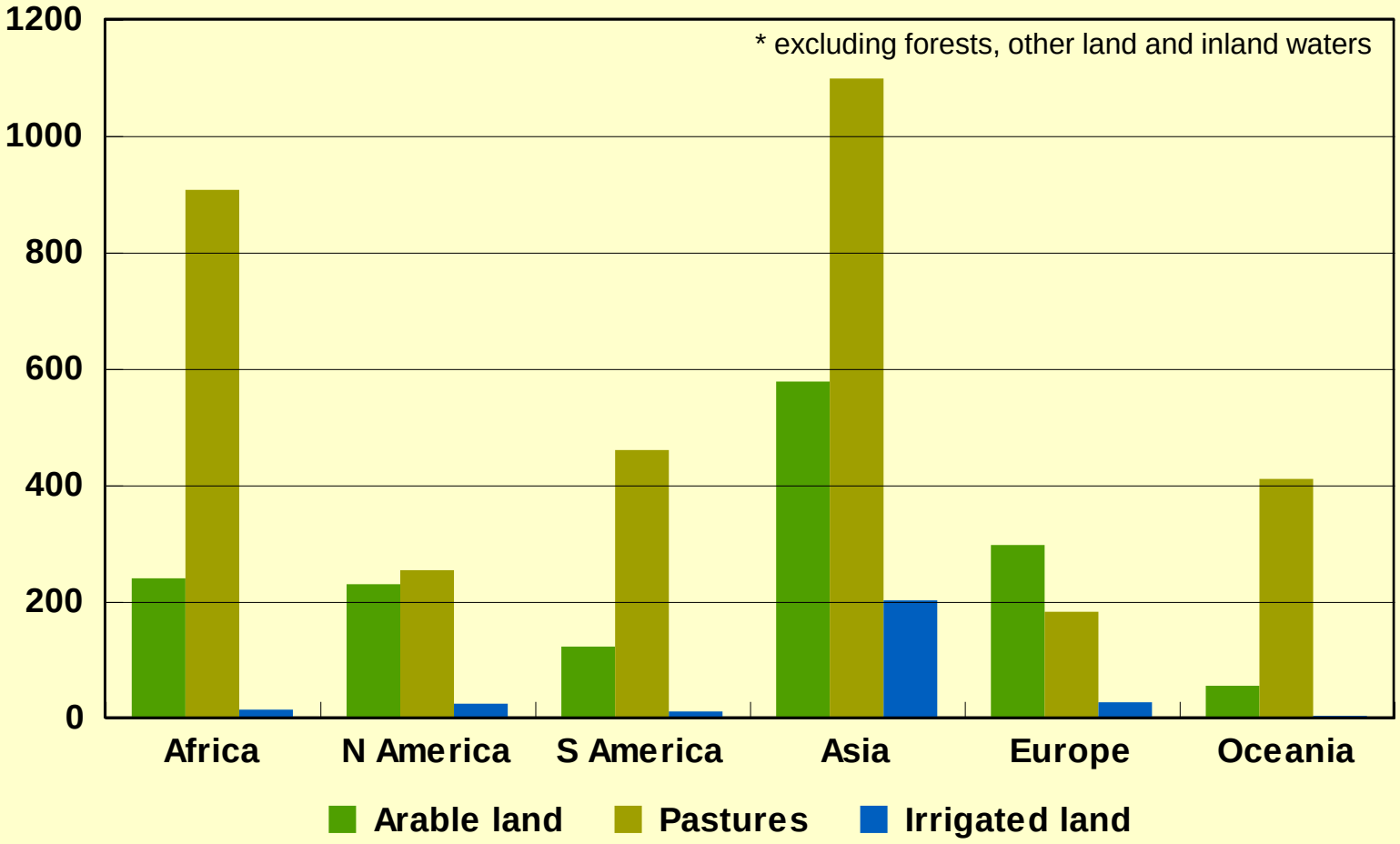
Main characteristics of BLUE and GREEN water

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**	**Rain fed 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/

Other considerations

Water for livestock feed: Some issues and questions

- Crops require 200 to 800 g of water to produce 1 g of dry matter
- Potatoes, sugar cane, elephant grass require approximately 500 g/g
- If crop residues are the only feed, is crop water **NOT** part of livestock water use?
- How much water used by animals is essential for enabling crop production?
  - animals needed for ploughing and other cultivation tasks
  - animals needed for transport of crops to market

Other water uses

- How much water is needed or used to:
  - maintain hygiene, animal health and food safety
  - process animal products (slaughtering, meat packaging, dairying)
- Can waste water safely be used to produce feeds?

Impact of beef production on water resources

Depletion, degradation, devaluation of water

- Sinking ground water levels through deep wells operation
- Evaporation/seepage from storage facilities
- Non-consumptive contamination, increasing hygienic risks, general health risks

Impact of beef production on water resources

Soils, hydrology and habitat

- Beef production affects soil moisture through
  - soil compaction, change of ground cover and run-off
  - change of soil organic matter and water holding capacity
- Contamination of soils, ground and surface water
- Over-grazing and loss of bio-diversity
- Habitat destruction, ground water recharge potential
- Trail and sheet erosion, sedimentation

Conclusions

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