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# Environmental impacts of German food consumption and food losses

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## Outline

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- Objectives, background & agreements
- System boundaries
- Data
- Simplifications, assumptions and allocations
- Results
- Discussion & conclusions



## Objectives

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- Aim of the study is to assess the environmental burdens of food consumption and food losses in Germany along the whole life cycle in order to propose measures for the reduction of environmentally relevant food waste



## Background & agreements

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- the orientative LCA is part of a project aiming to reduce food waste in Germany funded by the German Federal Environmental Agency

Agreements within the project:

- no differentiation between avoidable & unavoidable food losses
- drinks & sweets are excluded
- packaging & waste treatment are excluded

# Approach

- Starting point: consumers' food baskets in-house and out-of home

## in-house consumption

bread&cereals	93 kg
meat&meat products	33 kg
fish	4 kg
milk&dairy products	103 kg
fats&oils	7 kg
fruits	45 kg
vegetables	63 kg
sugar	6 kg
<b>Total</b>	<b>354 kg</b>

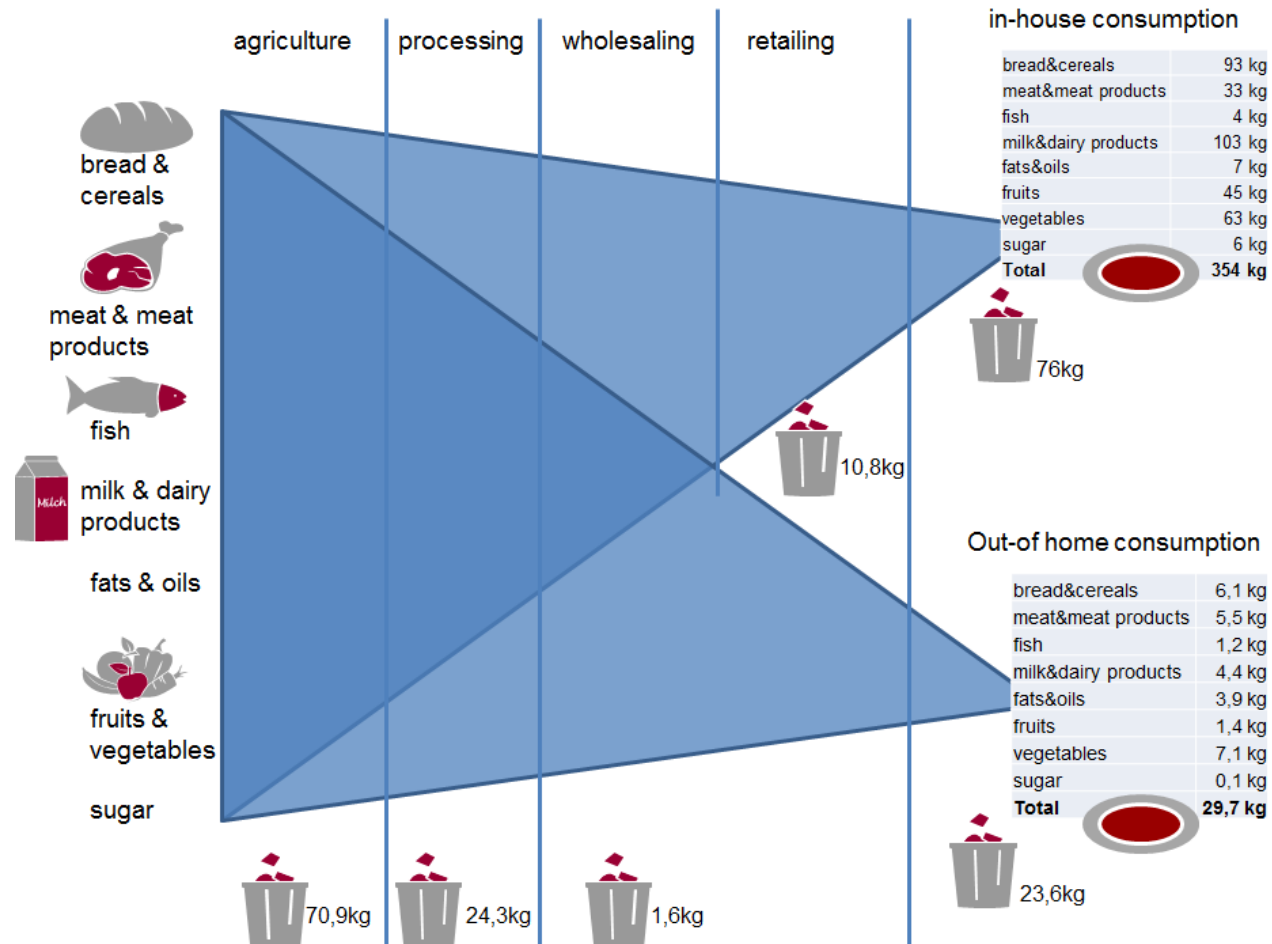


## Out-of home consumption

bread&cereals	6,1 kg
meat&meat products	5,5 kg
fish	1,2 kg
milk&dairy products	4,4 kg
fats&oils	3,9 kg
fruits	1,4 kg
vegetables	7,1 kg
sugar	0,1 kg
<b>Total</b>	<b>29,7 kg</b>



# Approach



## System boundaries

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- Agriculture/livestock: production energy; land, pesticide & fertilizer, water use for irrigation of plant products (incl. feed); direct emissions; feed transports & transports to food processing
- Processing: energy use, direct emissions; transports to retail
- Wholesaling/retailing: energy use, freezing agent losses, transports between wholesalers and retailers (only in-house consumption), transports from wholesalers to out-of home consumption (only out-of home consumption)
- In-house consumption: energy use for shopping trip, storing of purchased food & preparing of meals
- Out-of home consumption: energy use for food storage, preparing of meals & air conditioning of restaurants
- **Outside system boundaries**: seed production, water & land use outside agricultural production, customer trips to restaurants



## Data

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- Food consumption baskets: statistical data, e.g. German income & consumption sample, German production & trade statistics; data from previous projects, e.g. Eberle et al. 2006; Wiegmann et al. 2005
- Food losses: recent German studies on food losses (Kranert et al. 2012, Peter et al. 2013), FAO study (Gustavsson et al. 2011)
- Estimations for shares of food consumed cooked / raw
  
- Databases:
  - ecoinvent 3.01 for electricity grids, energy production, fertilizer & pesticides production, transports for all life cycle stages
  - GEMIS 4.81 for input & output data for agricultural production, food processing, retailing; exception: water use (blue water) from Mekkonen&Hoekstra 2010
  
- Land use & water use have been correlated with their national origins



## Simplifications & assumptions

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- all food imports are modelled on agricultural level
- all food processing takes place in Germany
- production of fodder components in all countries where we get livestock products from is done like in Germany with the same import countries & shares like in Germany; composition of livestock feed itself is modelled with country specific data
- all beef consumed is modelled as beef from fattening bulls, shares in milk cows meat is not considered; same assumption for poultry, shares in laying hens meat is not considered
- all food imports from overseas are done by ship
- organic production systems are not included
- all households buy their food at the retailer, purchases direct at the farm or at local markets are not considered
- all food for out-of home consumption is delivered by wholesalers

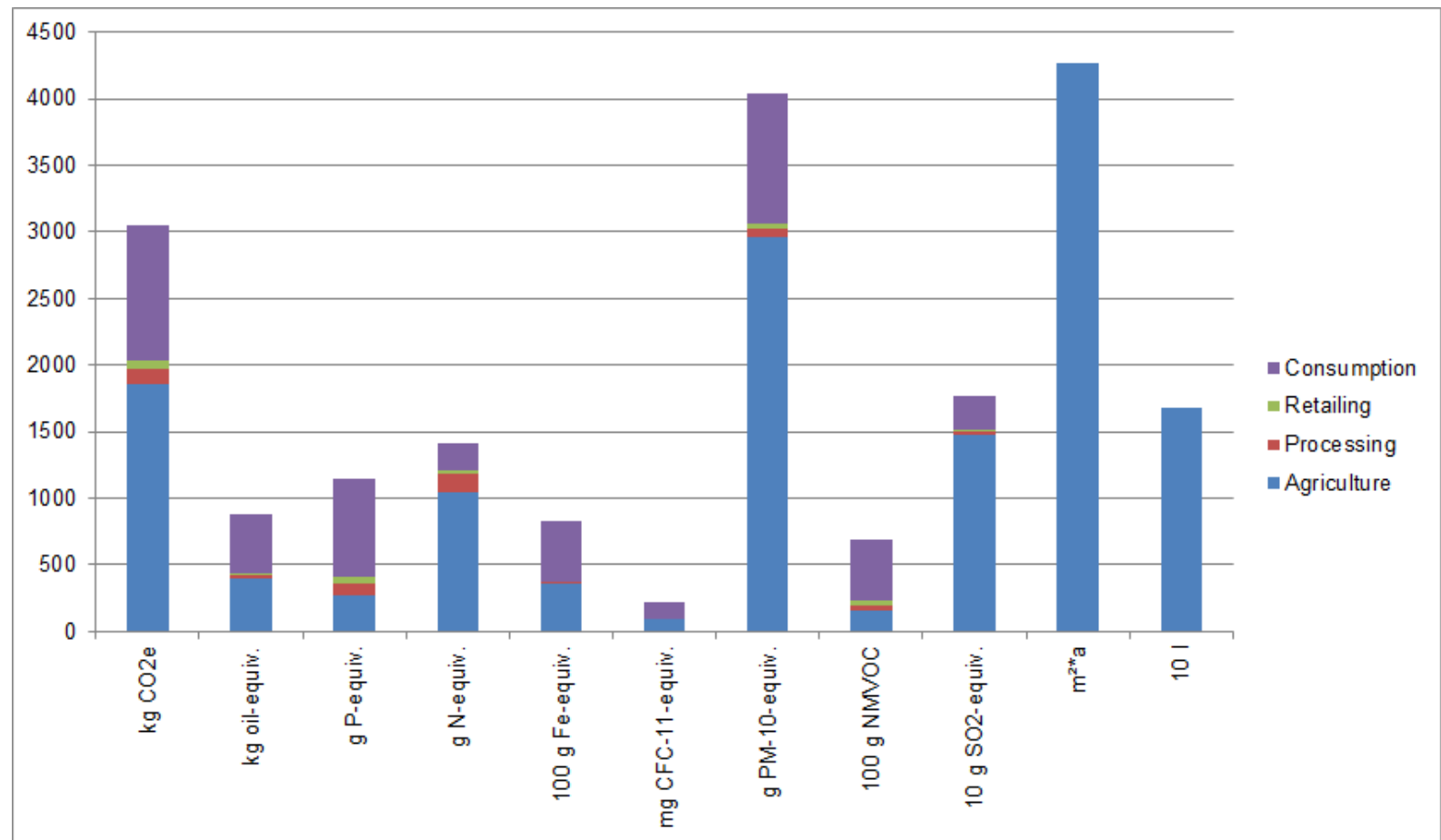
# Allocations

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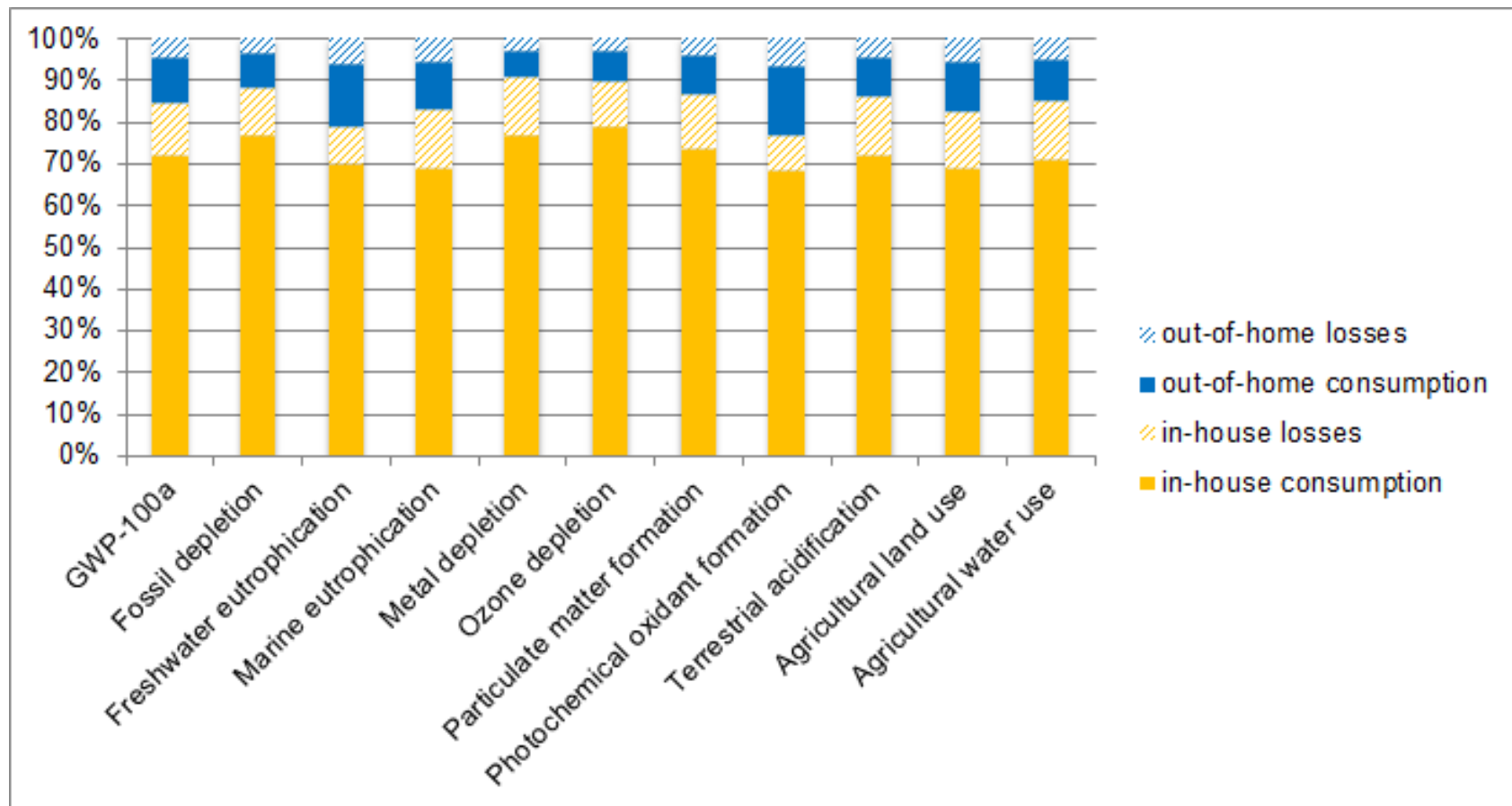
- food losses: mass allocation at all life cycle stages
- milk cow keeping: economic allocation, resulting in 80% of environmental burdens allocated to milk
- dairy production: allocation with respect to milk solids (Lundie et al. 2007)
- soy shred / oil: allocation regarding heating value equivalents
- all other cases of agricultural production: 100% allocation to the product
- This approach leads to a slight overestimation of environmental burdens in agriculture.
  
- combined power generation: allocation with respect to energy yield



# Environmental burdens of German food consumption

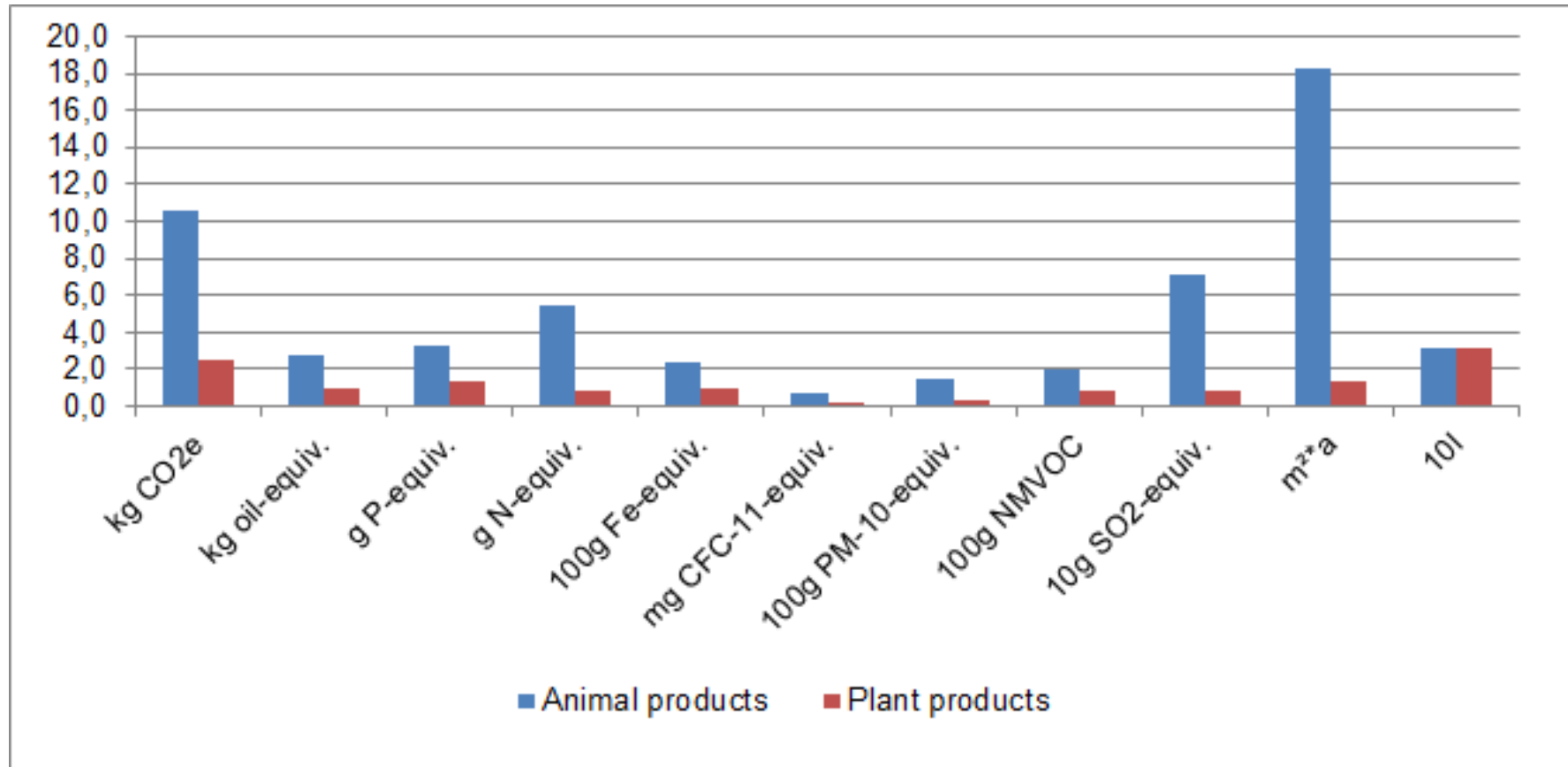


# Shares of in-house & out-of-home consumption and food losses

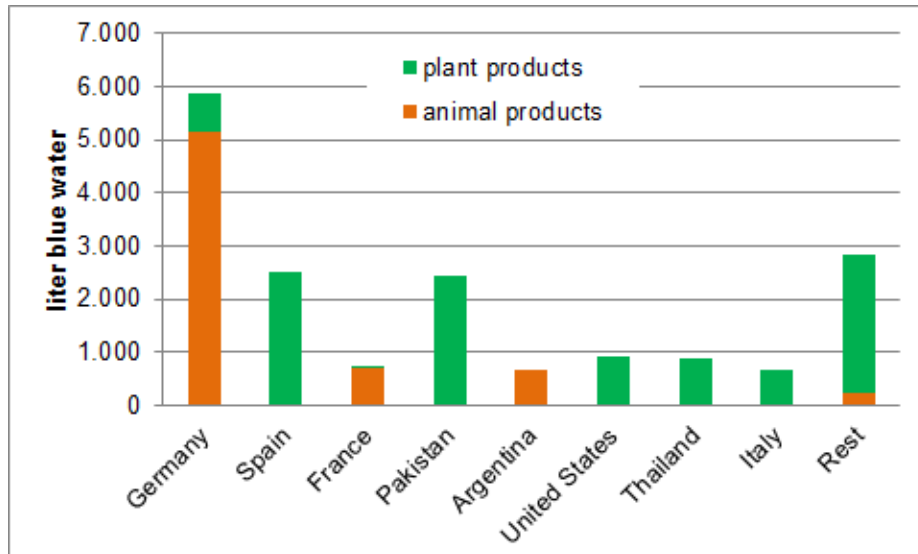




## High relevance of animal products

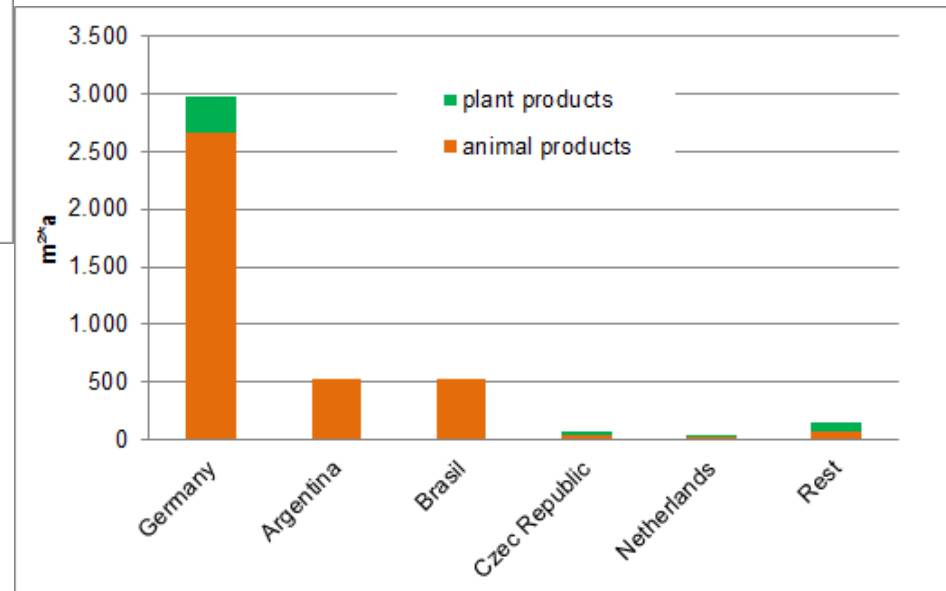


# Agricultural water & land use per country



- due to assumptions regarding feed production the share of Germany is somewhat overestimated

- due to assumptions regarding rice origin results for Pakistan could be different



## Discussion

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- high relevance of food consumption and losses: 27% of German greenhouse gas emissions per person; water use for food production is about 2/3 of households' water use
- similar dimension as results from previous studies
- inclusion of whole life cycle including households and all food losses along the chain lead to higher greenhouse gas emissions (shopping trip, households' energy consumption)
- differences in land use data: results depend highly on yield data, in our study we used data from GEMIS (based on data of the European CAPRI modelling system)





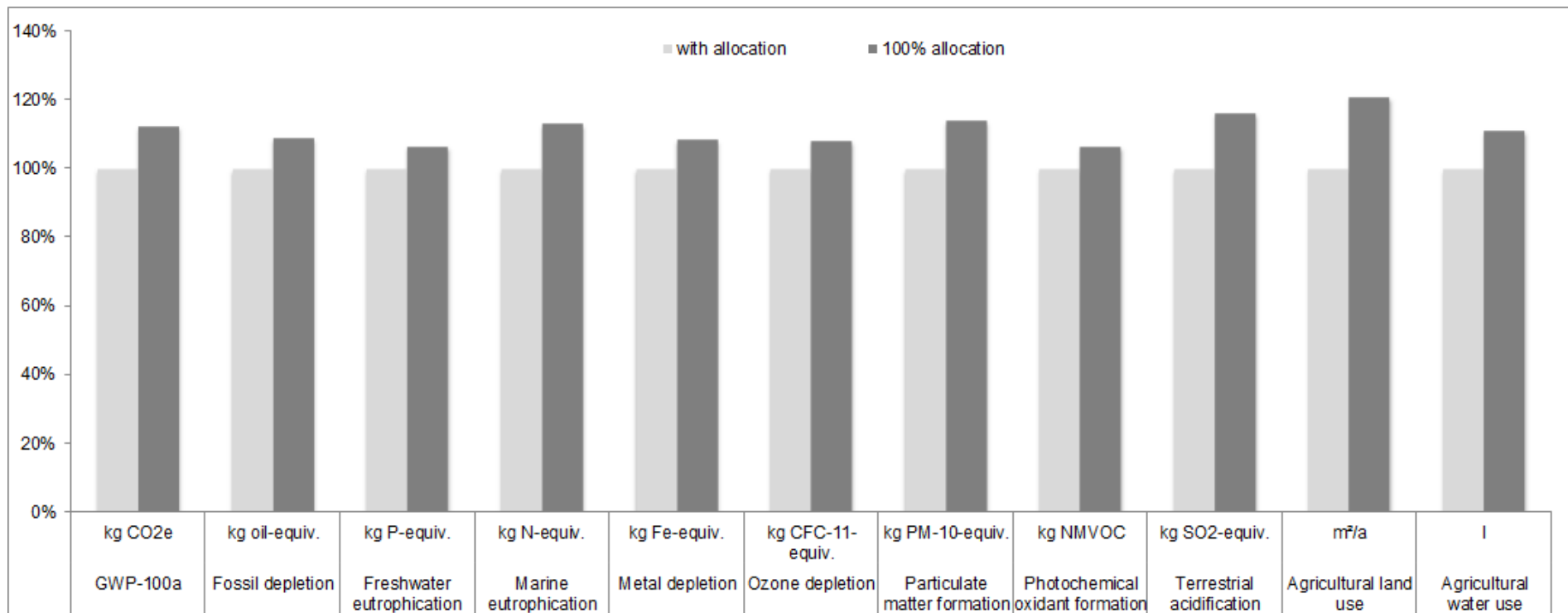
## Relevance of assumptions

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- shares of Germany are somewhat overestimated regarding land and water use due to the assumption that production of fodder components is done like in Germany, also the total amounts could change for that reason
- share of Pakistan in water use could be different due to lacking data on rice provenience for Germany
- share of agriculture in environmental burdens is somewhat overestimated

# Sensitivity analysis

- 100% allocation regarding milk cow keeping and dairy processing



## Conclusions

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- food consumption is highly relevant for German environmental impacts
- in particular animal products are responsible for high environmental burdens
- losses along the value chain have a share of 15 to 21% in environmental impacts
- Measures therefore should focus on the reduction of animal product food losses and on the reduction of the high share of food losses in out-of home consumption



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**Thank you very much for your attention!**

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