CLIMATE-SMART Agriculture 2015

Global Science Conference

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Le Corum, Montpellier France

Supply and demand based greenhouse gas mitigation

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GHG emissions from the AFOLU sector

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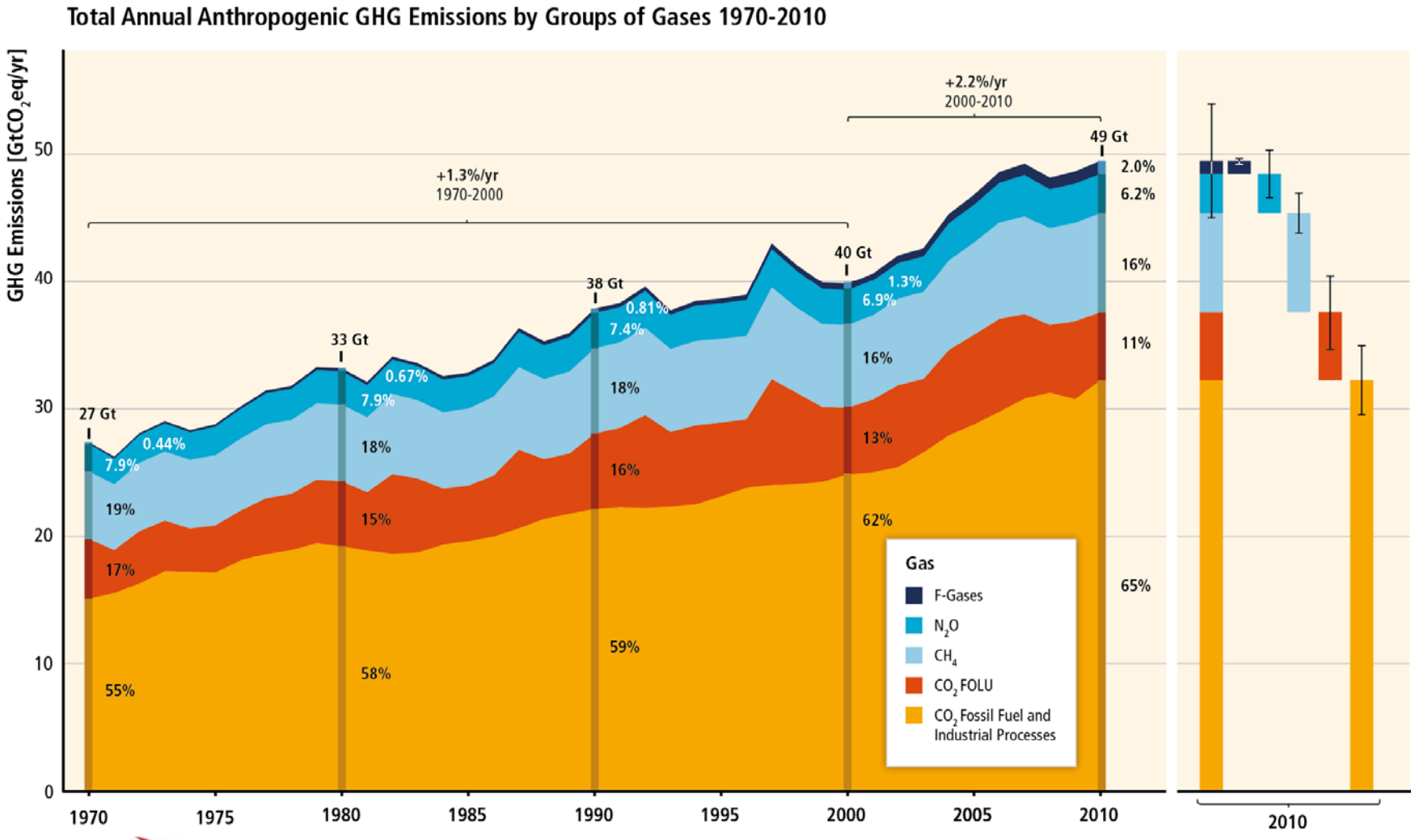
GHG emissions growth has accelerated despite policies. Most growth is CO_2 from fossil fuels



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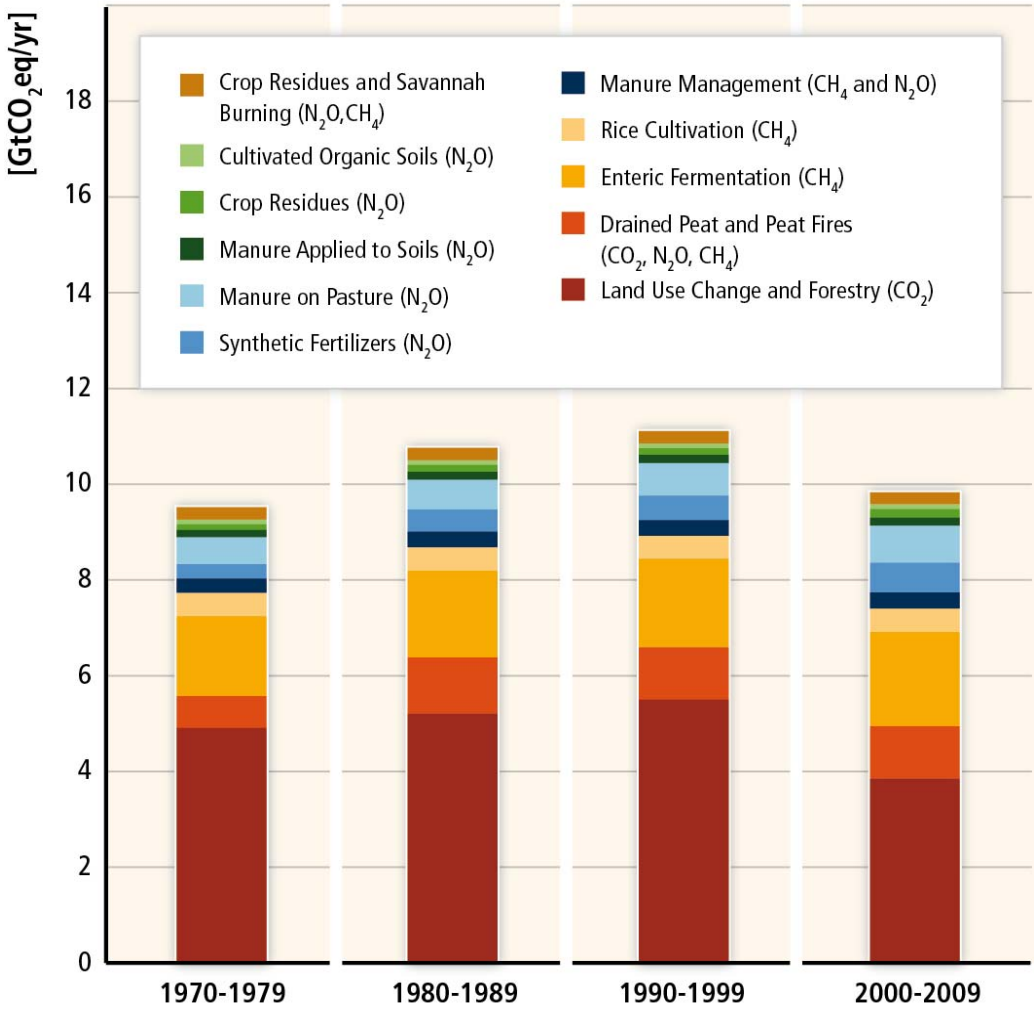
Agricultural emissions are increasing, but *net* forestry CO_2 emissions have fallen recently



- AFOLU accounts for 24% of total anthropogenic GHG emissions
- AFOLU is the only sector where net emissions fell in the most recent decade
- Whilst agricultural non-CO_2 GHG emissions increased, *net* CO_2 emissions fell, mainly due to decreasing deforestation, and increased afforestation rates

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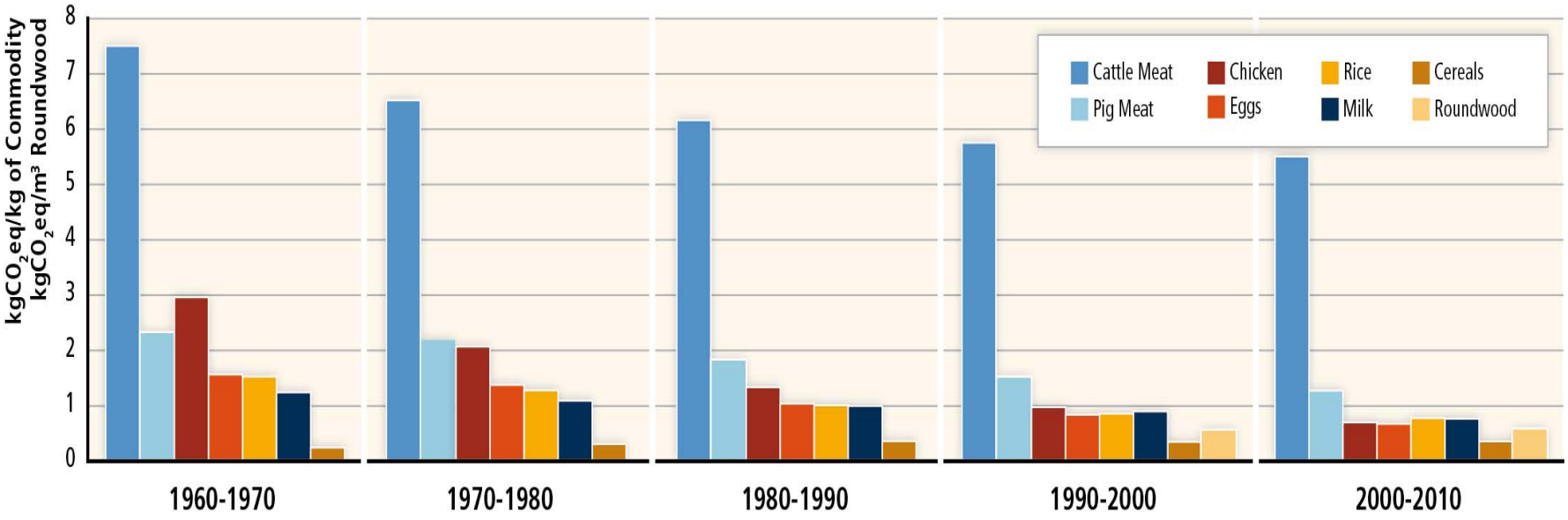
Smith *et al.* (2014) – IPCC WGIII AR5

Emissions intensity of AFOLU products is falling as agriculture and forestry become more efficient



- Note that ruminant meat has a GHG intensity much higher than other agricultural products
- But also note that these are direct emissions only. If we include the emissions from the human-edible feed for mono-gastric animal products, they move closer to ruminant meat

Smith *et al.* (2014) – IPCC WGIII AR5

Agricultural GHG mitigation – supply-side measures

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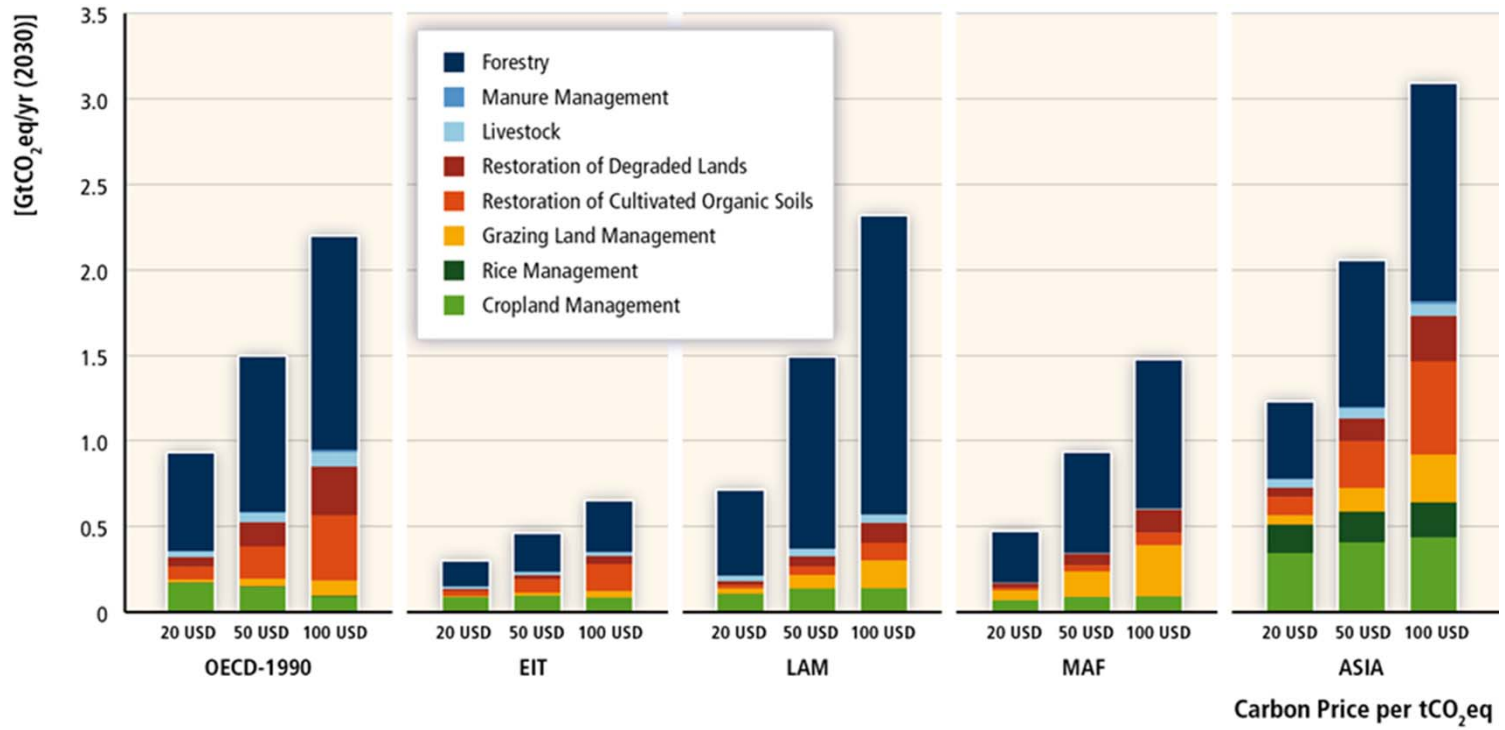
What is the potential of the mitigation options for reducing GHG emissions in the AFOLU Sector?



- Global economic mitigation potentials in agriculture in 2050 are estimated to be 0.5–10.6 $GtCO_2eq/yr$.
- Reducing food losses & waste: GHG emission savings of 0.6–6.0 $GtCO_2eq/yr$.
- Changes in diet: GHG emission savings of 0.7–7.3 $GtCO_2eq/yr$.
- Forestry mitigation options are estimated to contribute 0.2–13.8 $GtCO_2/yr$.

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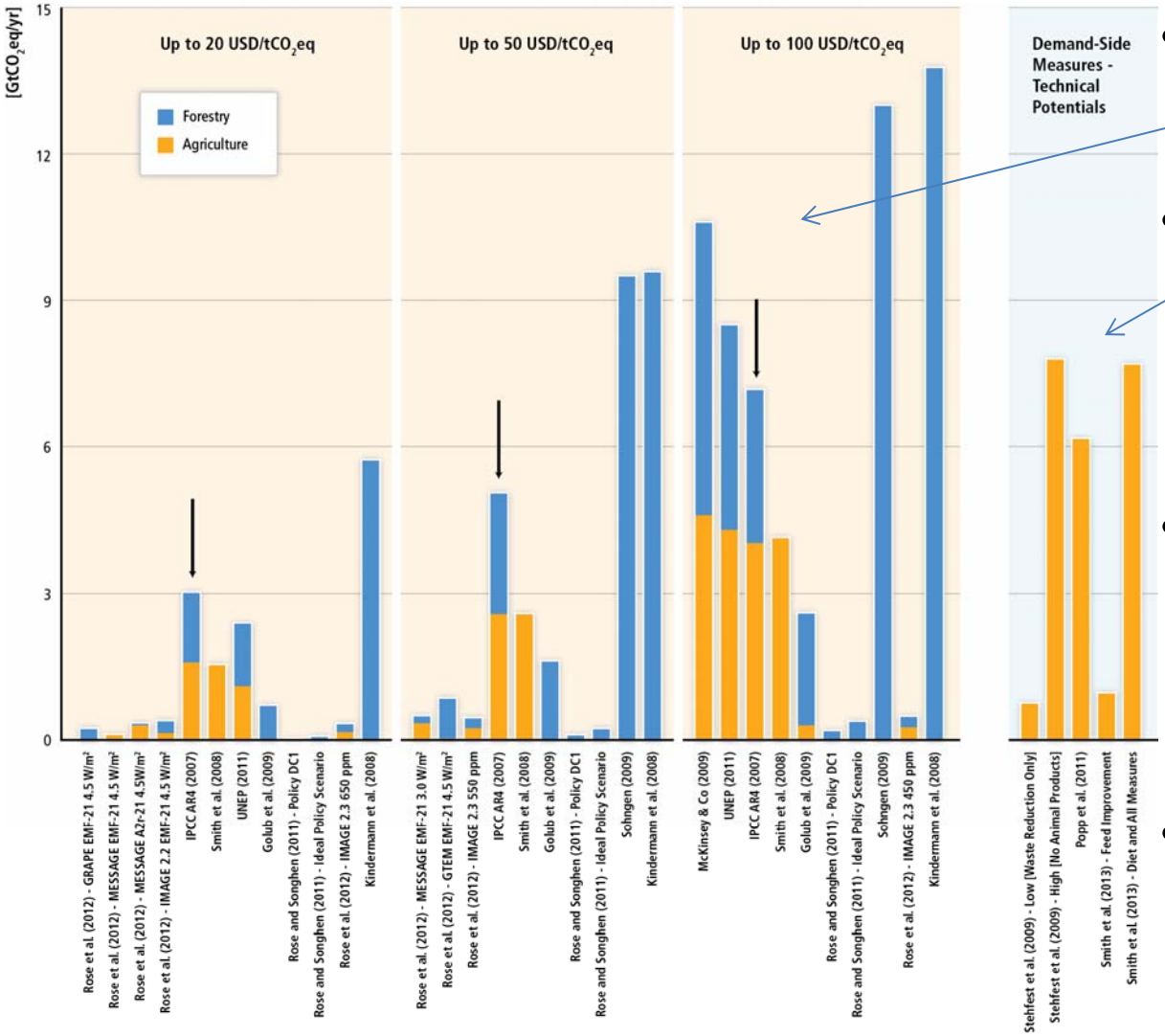
Smith *et al.* (2014) – IPCC WGIII AR5

Demand- and supply-side measures need to be considered



- Supply-side measures in the AFOLU sector are large & cost-competitive
- Demand-side measures such as dietary change and waste reduction also have large, but uncertain, mitigation
- Demand-side measures may be difficult to implement, but are worthy of further research
- Other options in the AFOLU sector include bioenergy

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Smith *et al.* (2014) – IPCC WGIII AR5

Agricultural GHG mitigation – demand-side measures

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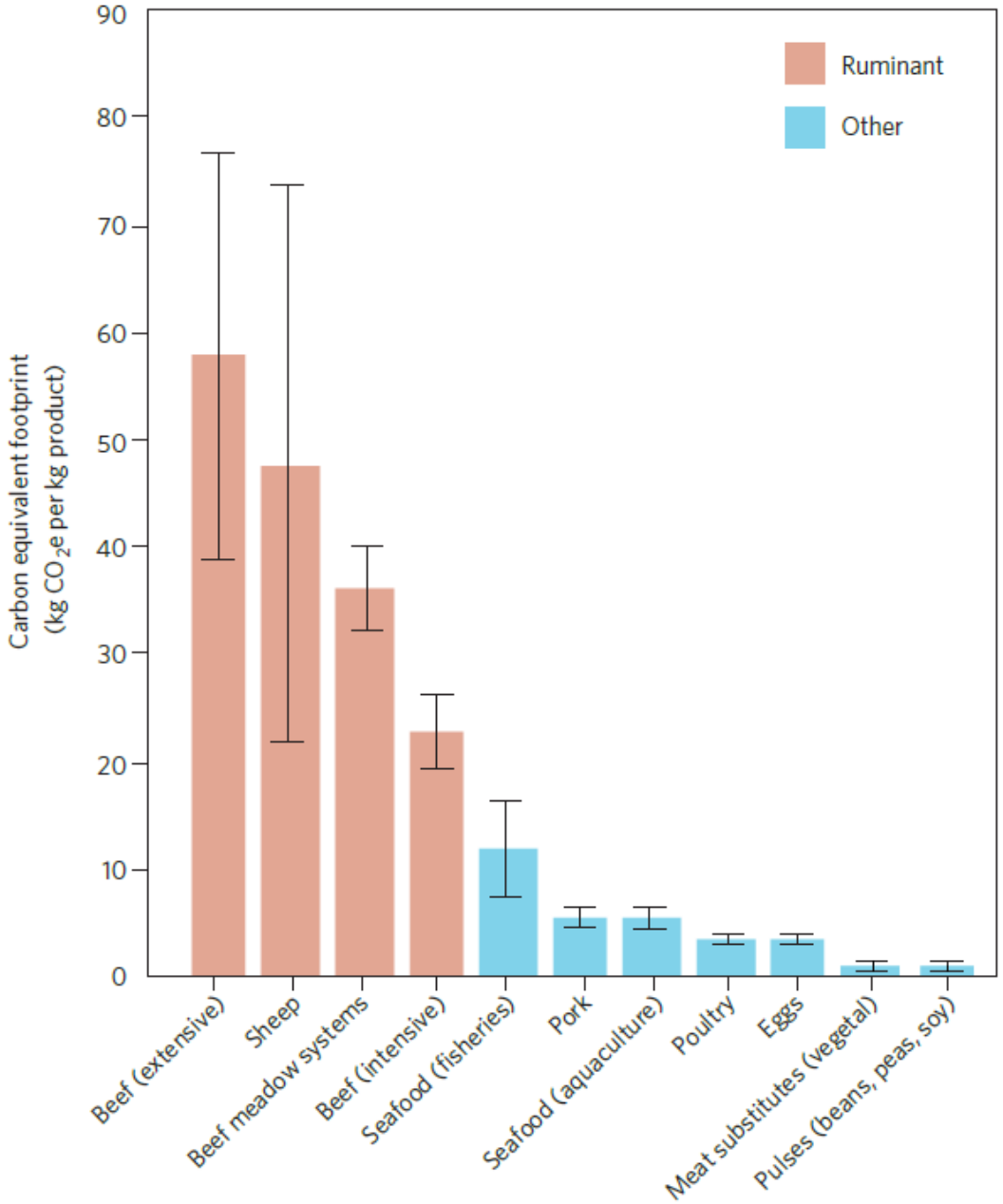
Big differences in the GHG intensity of different foods



Ripple *et al.*(2014)

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Changed consumption patterns

Table 3 Description of the reference scenario and the four dietary variants

Variant	Description
Reference	Agricultural production for 2000–2030 (Bruinsma 2003) and 2030–2050 (FAO 2006). The 2000–2030 projections are country-scale and aggregated to the 24 world regions of the IMAGE model. The projections for 2030–2050 have a continental scale
No Ruminant Meat (NoRM)	As reference, but with complete substitution of proteins from ruminant meat (cattle, buffaloes, sheep and goats) by plant-proteins, starting in 2010 and completed by 2030. By-products such as wool and leather are also assumed to be substituted by other materials
No Meat (NoM)	As NoRM, with additional substitution of white meat (pork, poultry) by plant proteins, starting in 2010 and completed by 2030
No Animal Products (NoAP)	As NoM, with additional substitution of milk and eggs by plant proteins, starting in 2010 and completed by 2030
Healthy Diet (HDiet)	"Healthy Eating" recommendations from the Harvard Medical School (Willett 2001) implemented globally for meat and eggs, starting in 2010 and completed by 2030. See also Table 4

Fewer animal products in global diet allows everyone to be fed, and land is available for energy and nature conservation

Land based GHG emissions:

	GtC eq.
2000	3.0
2050-Reference	3.3
2050-NoRM	1.7
2050-NoM	1.5
2050-NoAP	1.1
2050-HDiet	2.1

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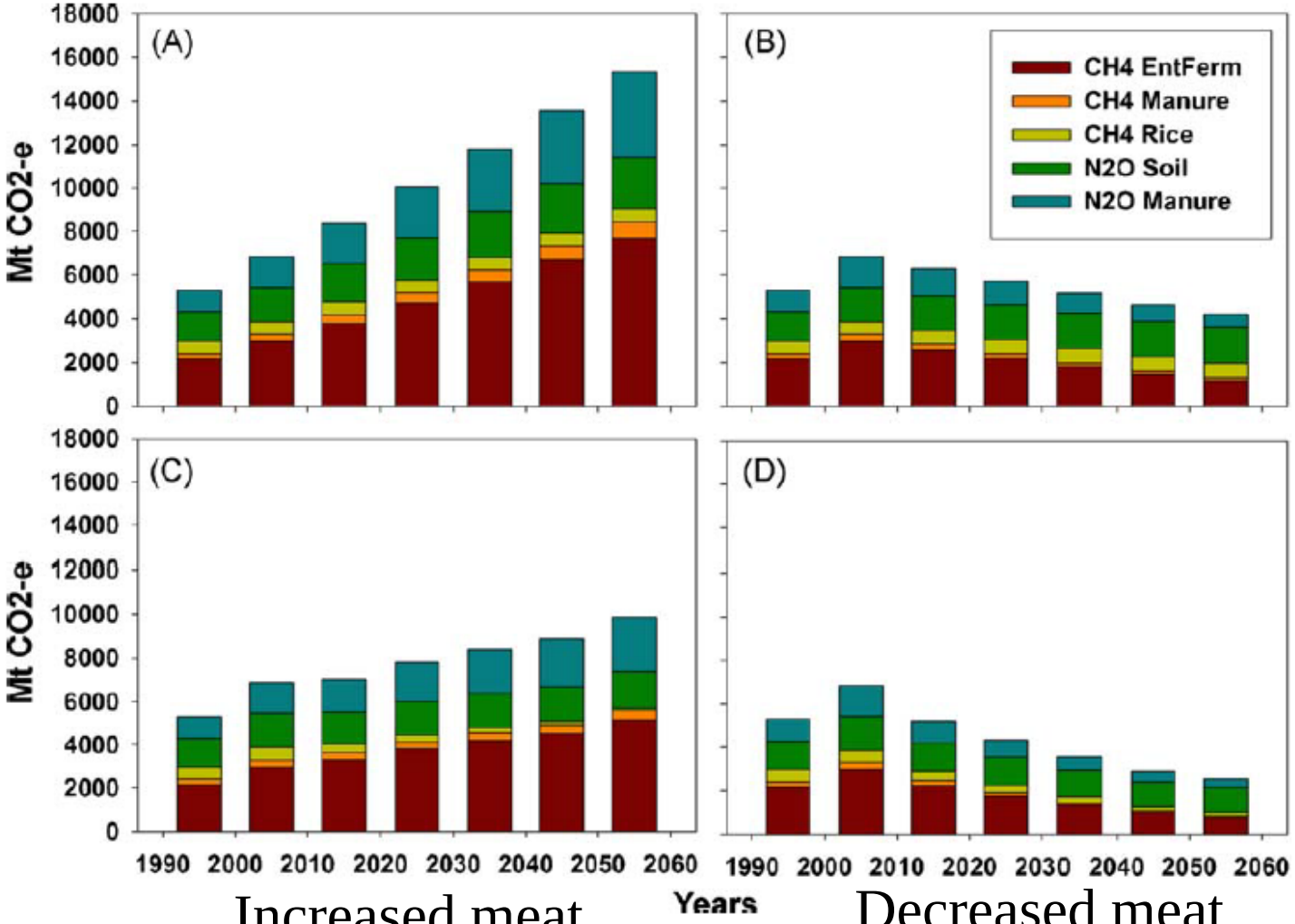
Stehfest *et al.* (2009)

Reducing GHG emissions – dietary change *vs*. technical mitigation

Without technical mitigation

With technical mitigation



Increased meat

Decreased meat

Popp *et al.* (2011)

Food demand must be managed because sustainable intensification alone will not suffice

Scenarios	Yields		Demand side reduction measures:	
	Current trends in yields	Yield gap closures (sustainable intensification)	50% Food waste reduction	Healthy diets
CT1	x			
CT2	x		x	
CT3	x		x	x
YG1		x		
YG2		x	x	
YG3		x	x	x

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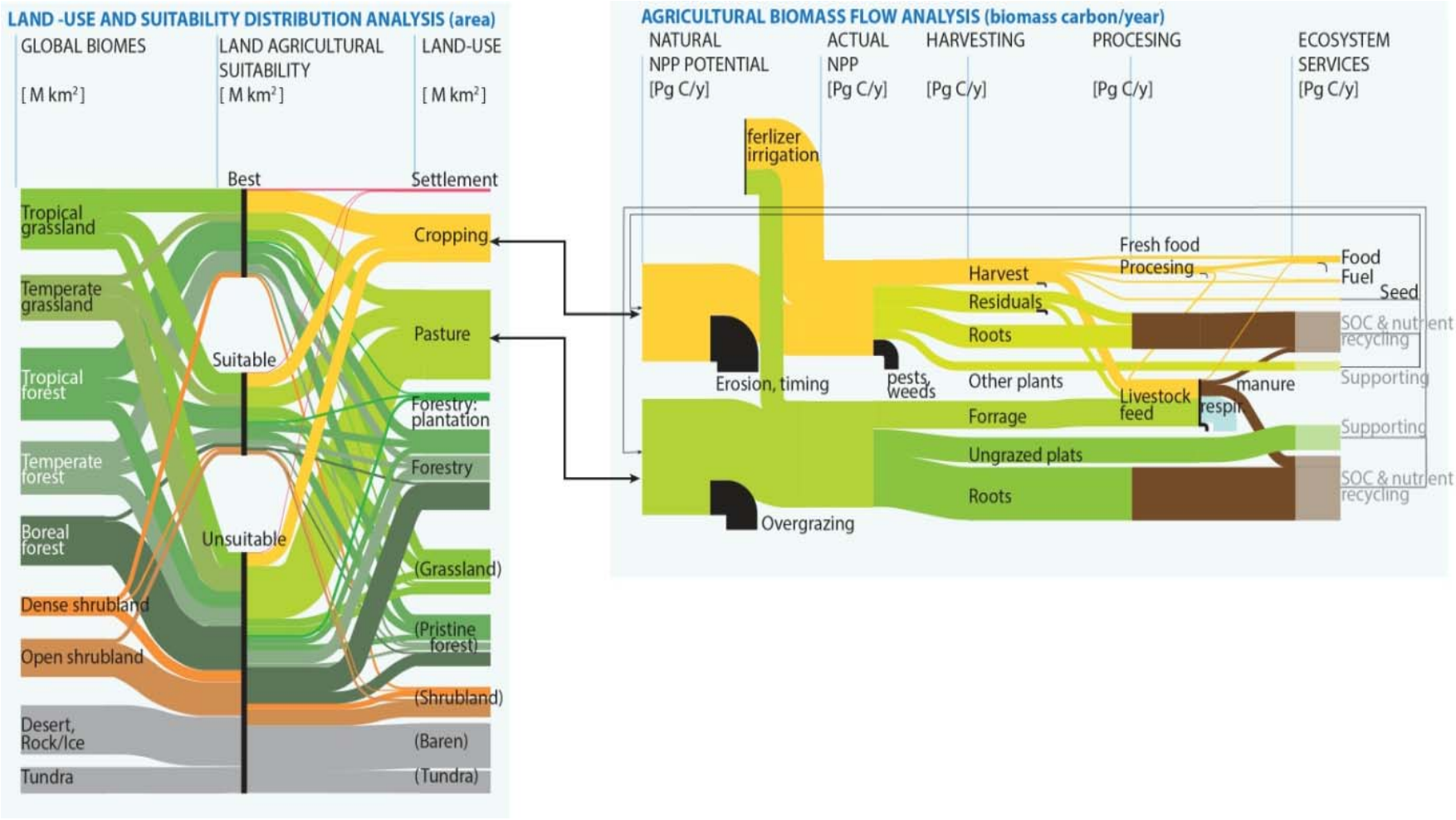
Bajželj *et al.* (2014) Nature CC

Food demand must be managed because sustainable intensification alone will not suffice



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Bajželj *et al.* (2014) Nature CC

Food demand must be managed because sustainable intensification alone will not suffice

Current yield trend

Yield gap closure only

Yield gap closure + demand options

	units	2009*	CT1		CT2		CT3		YG1		YG2		YG3	
Cropland	Mkm^2	15.6	22.5	(+44%)	18.7	(+20%)	17.6	(+12%)	18.2	(+16%)	16.0	(+2%)	14.6	(-6%)
Pasture	Mkm^2	32.8	35.2	(+7%)	32.6	(-1%)	26.8	(-18%)	36.0	(+10%)	33.1	(+1%)	27.1	(-17%)
Net Forest cover	Mkm^2	26.1	23.1	(-12%)	24.7	(-6%)	26.1	(+0%)	24.2	(-7%)	25.6	(-2%)	27.1	(+4%)
Tropical Pristine Forests	Mkm^2	7.9	7.2	(-9%)	7.4	(-7%)	7.4	(-6%)	7.4	(-6%)	7.6	(-4%)	7.6	(-4%)
Total GHG emissions	$GtCO_2/y$	13.5	22.2	(+64%)	16.1	(+20%)	11.7	(-13%)	19.2	(+42%)	15.0	(+11%)	10.2	(-25%)
Carbon sink potential	$GtCO_2/y$	14.7	14.5	(-1%)	14.6	(-0%)	14.8	(+0%)	14.6	(-1%)	14.7	(+0%)	14.7	(+0%)
Fertiliser use	Mt/y	103	166	(+61%)	136	(+32%)	125	(+22%)	226	(+120%)	196	(+90%)	175	(+70%)
Irrigation water use	km^3/y	2889	6496	(+125%)	5328	(+84%)	5075	(+76%)	5051	(+75%)	4413	(+53%)	4157	(+44%)

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Bajželj *et al.* (2014) Nature CC

How will food demand be met in future?

Smith (2014b)

Other papers arriving at similar conclusions……

ARTICLE

doi:10.1038/nature13959

Global diets link environmental sustainability and human health

David Tilman[1,2] & Michael Clark[1]

Diets link environmental and human health. Rising incomes and urbanization are driving a global dietary transition in which traditional diets are replaced by diets higher in refined sugars, refined fats, oils and meats. By 2050 these dietary trends, if unchecked, would be a major contributor to an estimated 80 per cent increase in global agricultural greenhouse gas emissions from food production and to global land clearing. Moreover, these dietary shifts are greatly increasing the incidence of type II diabetes, coronary heart disease and other chronic non-communicable diseases that lower global life expectancies. Alternative diets that offer substantial health benefits could, if widely adopted, reduce global agricultural greenhouse gas emissions, reduce land clearing and resultant species extinctions, and help prevent such diet-related chronic non-communicable diseases. The implementation of dietary solutions to the tightly linked diet–environment–health trilemma is a global challenge, and opportunity, of great environmental and public health importance.

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Taxes on food by GHG emissions?

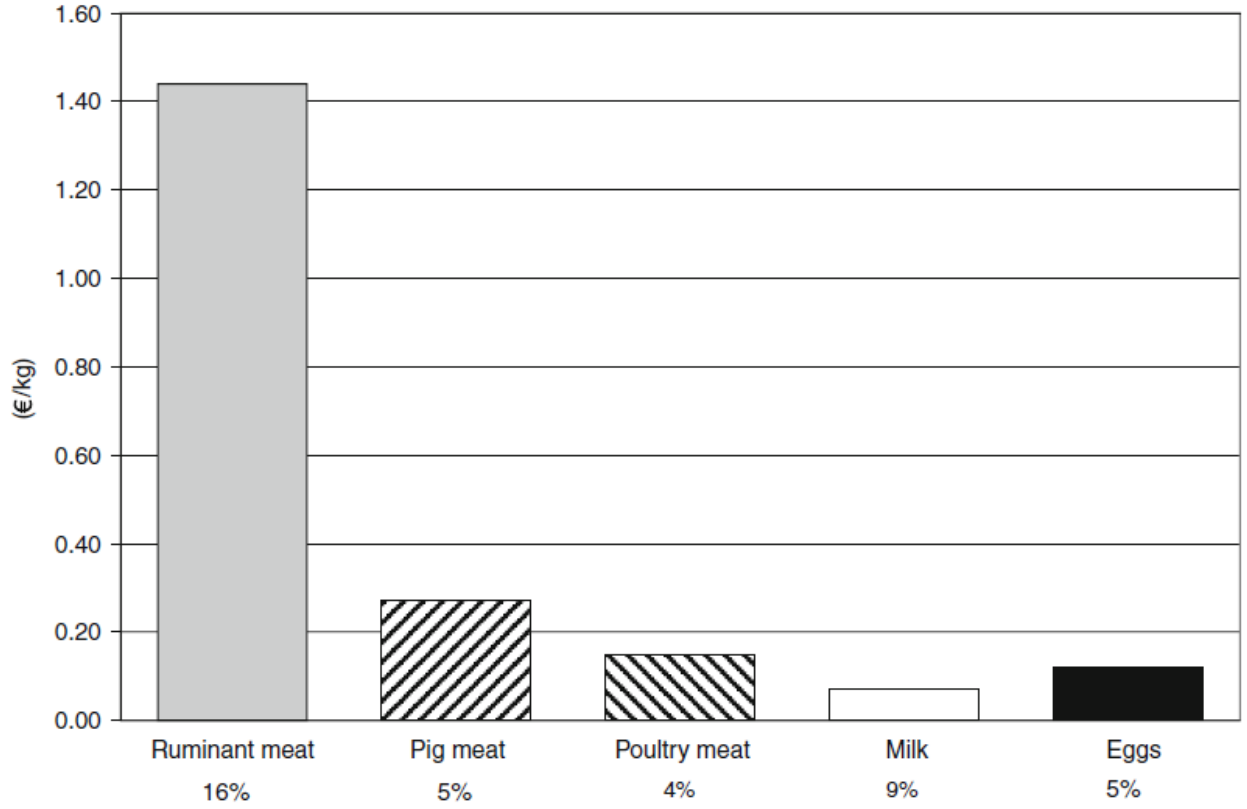

Fig. 9 Taxes per kg (fresh weight) food product for GHG weighted consumption taxes on animal food equivalent to €60 per ton CO_2-eq. *Percentages on top of bars* show the corresponding relative increase in consumer price

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Wirsenius *et al.* (2011)

Conclusions

- We can feed 9-10 billion people
- Food supply needs to be increased whilst reducing environmental impact of agriculture
- Need to find options and policies that co-deliver improved food security and improved environmental outcomes
- Some promising supply-side measures (e.g. efficiency improvements) improve food security and reduce environmental impact
- Demand-side measures (e.g. changing diets, waste reduction) are under-researched, for food security and for potential to reduce environmental impact
- We need to change consumption patterns (demand-side measures) – techno-fixes are not enough to make the necessary changes

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Smith (2014a)

Implications for policy

- Supply-side measures should be implemented immediately with focus on sustainable intensification
- Demand-side measures – it will take time for behaviour change to occur - policy should be introduced quickly, and should aim to co-deliver to other policy agendas
- Joined-up policy to address multiple objectives is required now more than ever.

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Smith (2014)

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