## Supplementary Table 1: Comparison of aggregate N quantity categories for SOLm and Tubiello 2013<sup>68</sup>

N (megatons)	SOLm	Tubiello 201368
N in manure (total in all manure	115	113
management systems incl. left on		
pastures)		
N in manure applied to croplands	20	25
N in manure applied to grasslands	48	40*
N from mineral fertilizers	98	100
N in total crop residues	34	30
N fixation in crops (without rice and	25	22**
sugar cane)		

\*equals the total N quantity in manure left on pastures minus the N volatized and leached from N in manure left on pastures \*\*the source for this number is not Tubiello (2013)<sup>68</sup> but Herridge et al. (2008)<sup>47</sup>.

## Supplementary Table 2: Comparison of aggregate GHG emission categories for SOLm, Tubiello 2013 and Gerber et al. 2013<sup>68,69</sup>

GHG emissions (gigatons)	SOLm	Tubiello 2013 <sup>68</sup>	Gerber et al. 2013 <sup>69</sup>
Methane from rice production	0.49	0.5	
Enteric fermentation	2.32	2.02	2.78
Manure management CH4	0.31	0.22	0.31
Manure management N2O total	0.31	0.12	0.37
Manure management N2O direct	0.11	0.11	
Manure management N2O indirect	0.2	0.01	
Synthetic fertilizer application (direct	0.58	0.65	
plus indirect)			
Crop residues application	0.16	0.18	
Manure application (on crops and	0.82	0.97	1.16
grass)			

#### **Supplementary Table 3: Pesticide model classifications**

#### Rating Pesticide level per crop (PUI)

- 0 No harmful pesticides\* used
- 1 Low level of pesticide application
- 2 Medium level of pesticide application
- 3 High level of pesticide application / harmful pesticides used\* \* WHO classification

#### Rating Pesticide legislation per country (PL)

- 0 All chem.-synthetic pesticides (WHO-classes 1-2) banned
- 1 Rigid pesticide legislation and control excludes harmful pesticides\*
- 2 Average pesticide legislation and control
- 3 Legislation does not preclude the use of harmful pesticides\* \*WHO classification

#### Rating Access to pesticides per country (AP)

- 0 Farmers have no access to chem.-synthetic (WHO-classes 1-2) pesticides
- 1 Only few farmers have access to chem.-synthetic pesticides (max. 10% of the cultivated land is treated with pesticides)
- 2 Some farmers have access to chem.-synthetic pesticides (10-50% of the land that deserves treatment is treated)
- 3 Many farmers have access to chem.-synthetic pesticides (min. 50% of the land that deserves treatment is treated)

<u> </u>	D.Y		<u> </u>	D.		<u> </u>	DY		<u> </u>		
Country	PL	AP	Country	PL	AP	Country	PL	AP	Country	PL	AP
Afghanistan	3	1	Ecuador	2.5	2.5	Maldives	2	2	Saudi Arabia	2	3
Albania	2.5	2.5	Egypt	2	3	Mali	2.5	1	Senegal	2	1
Algeria	2	2	El Salvador	2	3	Malta	1.5	3	Serbia	2	3
American Samoa	2	3	Equatorial Guinea	3	2	Marshall Islands			Serbia and		
Andorra	2	3	Eritrea	2.5	1	Martinique	2	3	Montenegro	2	3
Angola	3	1	Estonia	1.5	3	Mauritania	2.5	1	Seychelles	3	2
Anguilla	2	3	Ethiopia	2	1.5	Mauritius	2	2	Sierra Leone	3	1
Antigua and Barbuda	2	3	Falkland Islands			Mayotte	3	1	Singapore	2.5	2.5
Argentina	2	2.5	(Malvinas)	2	3	Mexico	2	2.5	Slovakia	2	3
Armenia	3	3	Faroe Islands	1	3	Micronesia			Slovenia	2	3
Aruba	2	3	Fiji	2	3	(Federated States of)	2	3	Solomon Islands	2	3
Australia	1	3	Finland	1	3	Mongolia	3	1	Somalia	3	1
Austria	1	3	France	1	3	Montenegro	2	3	South Africa	2	2
Azerbaijan	3	2	French Guiana	2	2	Montserrat	2	3	Spain	1.5	3
5	2		French Polynesia	1.5	3	Morocco	1	2	Sri Lanka	2.5	1
Bahamas		3	5		1.5						1
Bahrain	2	2.5	Gabon	3 2.5		Mozambique	2 3	2 1	Sudan	3 2.5	
Bangladesh	3	1	Gambia		1	Myanmar			Suriname		2
Barbados	2	3	Georgia	3	2	Namibia	2	2	Swaziland	3	2
Belarus	2.5	3	Germany	1	3	Nauru	2	3	Sweden	1	3
Belgium	1	3	Ghana	2	1.5	Nepal	3	1	Switzerland	1	3
Belize	2	3	Gibraltar	2	3	Netherlands	1	3	Syrian Arab Republic	2	2
Benin	2.5	1	Greece	2	3	Netherlands Antilles	2	3	Tajikistan	3	2
Bermuda	2	3	Greenland	1	2.5	New Caledonia	1.5	3	Thailand	2.5	1
Bhutan	3	1.5	Grenada	2	3	New Zealand	1	3	The former Yugoslav		
Bolivia (Plurinational			Guadeloupe	2	2.5	Nicaragua	2	2.5	Republic of		
State of)	3	2	Guam	2	3	Niger	2.5	1	Macedonia	2	3
Bosnia and		_	Guatemala	2	3	Nigeria	3	1	Timor-Leste	3	1
Herzegovina	2	3	Guinea	2.5	1	Niue	2	2.5	Togo	2.5	1
Botswana	2	1.5	Guinea-Bissau	3	1	Norfolk Island	-	2.0	Tokelau	2.5	2.5
Brazil	1.5	2.5	Guyana	2.5	2	Northern Mariana			Tonga	2	2.5
			Haiti	2.3	2	Islands			Trinidad and Tobago	2	3
British Virgin Islands	2	3	Honduras	2 2	3		1	3	Tunisia	2	2
Brunei Darussalam	2	2				Norway	1	5			
Bulgaria	2.5	3	Hungary	2	3	Occupied Palestinian			Turkey	2	2
Burkina Faso	2.5	1	Iceland	1	3	Territory	3	1	Turkmenistan	3	2.5
Burundi	2	2	India	3	1.5	Oman	2	3	Turks and Caicos		
Cambodia	3	1	Indonesia	3	1	Pakistan	3	1	Islands	2	3
Cameroon	3	2	Iran (Islamic Republic			Palau			Tuvalu	2	2.5
Canada	1	3	of)	3	2	Panama	2	3	Uganda	2	2
Cape Verde	3	1.5	Iraq	2	2	Papua New Guinea	2.5	1.5	Ukraine	2.5	3
Cayman Islands	2	3	Ireland	1	3	Paraguay	2	3	United Arab Emirates	2	3
Central African			Isle of Man	1	3	Peru	2.5	2	United Kingdom	1	3
Republic	3	1	Israel	2	3	Philippines	2.5	1.5	United Republic of		
Chad	3	1	Italy	1.5	3	Pitcairn Islands			Tanzania	2	2
Channel Islands	1	3	Jamaica	2	2.5	Poland	2	3	United States of		
Chile	2	3	Japan	1	3	Portugal	1	3	America	1	3
China	3	2	Jordan	2	3	Puerto Rico	2	2	United States Virgin		
Colombia	2	2.5	Kazakhstan	3	2	Qatar	2	3	Islands	1.5	3
Comoros	2	2.5	Kenya	2	2	Republic of Korea	1.5	3	Uruguay	2	3
	3	1	Kiribati	2	3	Republic of Moldova	3	2.5	Uzbekistan	3	2
Congo Ca ala Jalan da			Kuwait	2	3	Réunion	3		Vanuatu	2	3
Cook Islands	1.5	3						2		2	3
Costa Rica	2	3	Kyrgyzstan	3	2	Romania	2	3	Venezuela		
Côte d'Ivoire	3	1	Lao People's			Russian Federation	3	2	(Bolivarian Republic		
Croatia	1.5	3	Democratic Republic	3	1	Rwanda	2	2	of)	2	2.5
Cuba	2.5	2	Latvia	1.5	3	Saint Helena	3	1	Viet Nam	3	1
Cyprus	2	3	Lebanon	2	2	Saint Kitts and Nevis	2	3	Wallis and Futuna		
Czech Republic	2	3	Lesotho	2	2	Saint Lucia	2	3	Islands	2	3
Democratic People's			Liberia	3	1	Saint Pierre and			Western Sahara	2	1
Republic of Korea	3	1.5	Libya	2	2	Miquelon	1	3	Yemen	2	2
Democratic Republic			Liechtenstein	2	3	Saint Vincent and the			Yugoslav SFR	2	3
of the Congo	3	1	Lithuania	1.5	3	Grenadines	2	3	Zambia	3	1.5
Denmark	1	3	Luxembourg	1	3	Samoa	2	3	Zimbabwe	3	1
Djibouti	3	2	Madagascar	2	2	San Marino	2	3	-	-	
Dominica	2	2.5	Malawi	2	2	Sao Tome and	-	-			
Dominican Republic	2	2.5	Malaysia	2	1.5	Principe	3	2			
1			tion: $AP = accessibil$			1	5	-			

## Supplementary Table 4: Country-specific ratings of pesticide legislation (PL) and the accessibility of pesticides to farmers (AP)

Dominican Republic22.5Malaysia21.5PrincipePL = Pesticide legislation;AP = accessibility of pesticides to farmers

### Supplementary Table 5: Crop-specific pesticide use intensity (PUI)

PUI

 $\begin{array}{c} 2\\ 3\\ 3\\ 3\\ 0\\ 0\\ 0\\ 2\\ 3\\ 0\\ 0\\ 0\\ 2\\ 3\\ 0\\ 0\\ 2\\ 2\\ 1\\ 3\\ 1\\ 0\\ 2\\ 2\\ 1\\ 3\\ 1\\ 0\\ 2\\ 2\\ 1\\ 3\\ 1\\ 0\\ 2\\ 2\\ 2\\ 2\\ 2\\ 2\\ 2\\ 3\\ 2\\ 2\\ 2\\ 2\\ 2\\ 2\\ 2\\ 3\\ 3\\ 3\\ 3\\ 2\\ 1\\ 2\end{array}$ 

Activity	PUI	Activity
Agave Fibres Nes	1	Ginger
Alfalfa For Forage+Silag	0	Gooseberries
Alfalfa Meal And Pellets	0	Grapefruit (inc. pomelos)
Almonds, with shell	2	Grapes
Anise, badian, fennel, corian.	1	Grass
Apples	3	Grasses Nes,Forage+Silag
Apricots	3	Groundnuts, with shell
Arabic Gum	0	Gums Natural
Arecanuts	0	Hay (Clover,Lucerne,Etc)
	2.5	Hay (Unspecified)
Artichokes		Hay Non-Leguminous
Asparagus	2.5	
Avocados	3	Hazelnuts, with shell
Bambara beans	2	Hemp Tow Waste
Bananas	3	Hempseed
Barley	2	Hops
Beans, dry	3	Jojoba
Beans, green	2	Jute
Beets For Fodder	0	Kapok Fruit
Berries Nes	2	Karite Nuts (Sheanuts)
Blueberries	2	Kiwi fruit
Brazil nuts, with shell	1	Kolanuts
Broad beans, horse beans, dry	3	Leguminous Nes,For+Sil
Buckwheat	1	Leguminous vegetables, nes
Cabbages and other brassicas	3	Lemons and limes
Canary seed	1	Lentils
Carobs	2	Lettuce and chicory
Carrots and turnips	3	Linseed
Cashew nuts, with shell	1.5	Lupins
Cashewapple	2	Maize
Cassava	2.5	Maize For Forage+Silage
Castor oil seed	3	Maize, green
Cauliflowers and broccoli	3	Mangoes, mangosteens, guava
Cereals, most	0	Manila Fibre (Abaca)
Cereals, nes	2	Maple
Cherries	3	Maté
Chestnuts	1.5	Melonseed
Chick peas	3	Millet
Chicory roots	2.5	Mixed grain
Chillies and peppers, dry	2.5	Mules
Chillies and peppers, green	2.5	Mushrooms and truffles
Cinnamon (canella)	2	Mustard seed
Citrus fruit, nes	3	Natural rubber
Clover For Forage+Silage	0	Nutmeg, mace and cardamom
Cloves	3	Nuts, nes
Cocoa beans	3	Oats
		Oil Of Citronella
Coconuts	2.5	ou 1 0 1
Coffee, green	3	Oil palm fruit
Coir	2	Oils Marine Animals
Cow peas, dry	3	Oilseeds, Nes
Cranberries	1	Okra
Cucumbers and gherkins	3	Olives
Currants	2	Onions (inc. shallots), green
Dates	3	Onions, dry
Eggplants (aubergines)	3	Oranges
Eggs Excl Hen	0	Other Bastfibres
Fibre Crops Nes	3	Other melons (inc.cantaloupes
Figs	2	Papayas
Flax fibre and tow	2	Peaches and nectarines
Fonio	1	Pears
Forage Products Nes	0	Peas, dry
		Peas, green
Fruit Fresh Nes	3	
Fruit, tropical fresh nes	3	Pepper (Piper spp.)
Fruits, most	0	Peppermint
Garlic	1.5	Persimmons

Activity	PUI
Pigeon peas	2
Pineapples	2.5
Pistachios	1
Plantains	3
Plums and sloes	3
Pome Fruit Nes	3
Popcorn	2.5
Poppy seed	1
Potatoes	3
Pulses, nes	2
Pumpkins, squash and gourds	3
Pyrethrum,Dried	0
Quinces	3
Quinces	1
-	
Ramie	1
Rapeseed	3
Raspberries	3
Rice, paddy	3
Roots and Tubers, most	0
Roots and Tubers, nes	2.5
Rye	1
Safflower seed	2
Seed cotton	3
Sesame seed	2
Sisal	2
Sorghum	2.5
Sour cherries	3
Soybeans	3
Spices, nes	2
Spinach	3
Starch and Sugar crops for Alc	Ĩ
	3
Stone fruit, nes Straw, Husks	(
-	
Strawberries	
String beans	3
Sugar beet	2.5
Sugar cane	3
Sugar crops, nes	2.5
Sunflower seed	1
Swedes For Fodder	(
Sweet potatoes	2.5
Tallow tree	(
Tangerines, mandarins, clem.	3
Taro (cocoyam)	2.5
Tea	3
Tea Nes	(
Tobacco, unmanufactured	3
Tomatoes	3
Triticale	2
Tung Nuts	- 1
•	
Turkeys	(
Turnips For Fodder	(
Vanilla	2
Vegetables fresh nes	2.5
Vegetables, most	(
Vegetables+Roots,Fodder	(
Vetches	1
Walnuts, with shell	1.5
Watermelons	3
vv aterinerons	
	2
Wheat Yams	2 2.5

PUI = Pesticide use intensity; Nes = other, not elsewhere specified

CC in	npacts	s on y	yields	6		ze	ro			medium high											
		% or	qanic	0	20	40	60	80	100							_					
	≥	0	100	0	5	10	17	25	33	21	26	33	40	47	57	46	50	54	58	64	71
	Conv	0	50	-16	-12	-8	-4	2	8	2	7	10	16	22	27	25	26	29	32	35	40
	0		0	-26	-24	-20	-16	-12	-8	-9	-6	-3	1	5	9	12	13	14	15	17	20
	Ð		feed	-6	-1	5	10	18	26	14	20	25	32	40	48	39	42	45	50	56	61
	0	25	eting	-22	-18	-13	-8	-4	-2	-4	0	5	9	14	21	18	20	22	25	27	32
	CC impact: Org		% reduction in food-competing feed	-30	-27	-25	-21	-17	-13	-14	-11	-8	-5	-1	4	6	7	8	8	10	13
High yield gap	imp		o-poo	-11	-7	-1	5	11	20	8	13	18	25	32	40	30	34	38	42	47	53
d d	S		n in f	-25	-23	-19	-14	-9	-4	-9	-6	-2	3	8	14	10	12	15	17	21	25
iel	0	50	ductic	-35	-32	-29	-25	-22	-18	-19	-17	-13	-10	-7	-3	-1	0	1	3	4	7
У С	>		% re							21	25	30	35	41	48	46	48	51	53	57	60
ligl	ú o	%)	%)				C	)%		2	5	8	12	16	21	25	25	26	27	29	31
Т	0 v	reduction (%)								-9	-7	-5	-3	0	3	12	11	11	11	12	12
	Ð	lcti								14	18	23	27	33	40	39	41	42	45	48	52
	0	g					25	5%		-4	-1	23	6	9	14	18	18	19	21	22	24
	act	20					20	//0						-							
	g	ag								-14	-12	-10	-8	-6	-3	6	6	5	6	6	6
	CC impact: Org < Conv	Wastage								8	11	16	21	26	32	30	32	34	37	40	43
	8	5 ≥ 50%								-9	-7	-4	0	3	8	10	11	12	13	15	17
		50%								-19	-18	-15	-13	-11	-8	-1	-1	-1	-1	-1	0

Supplementary Figure 1: Cropland area change with high yield gaps assumed

Percentage change in cropland areas with respect to the reference scenario (0% organic agriculture, no changes in livestock feed and food waste). Calories are kept constant for all scenarios. High yield gaps<sup>10</sup>; scenarios differ in organic shares (0-100%); impacts of climate change on yields (low, medium, high; lower impacts for organic than conventional agriculture); food-competing feed reductions (0, 50, 100% reduced from the levels in the reference scenario) and wastage reduction (0,25,50% with respect to the reference scenario). Colour code for the relation to reference scenario value that is displayed in dotted grey: >+5%: red, <-5% blue, between -5% and +5% yellow; in the reference scenario, cropland areas are 6% higher than in the baseline today.

CC ir	impacts on yields zero										medium						high							
		% or	ganic	0	20	40	60	80	100	_				_	_	_								
	>	0	100	0	3	6	8	12	16	21	25	28	32	36	41	46	49	52	55	58	61			
	Conv	0	50	-16	-14	-12	-10	-8	-5	2	5	7	9	12	15	25	26	28	29	31	33			
	"		0	-26	-25	-24	-22	-20	-19	-9	-8	-6	-4	-2	0	12	12	13	14	15	16			
	Drg		feed	-6	-3	0	3	7	10	14	18	21	25	28	32	39	41	43	46	49	53			
	t: O	25	eting	-21	-19	-17	-15	-13	-10	-4	-1	1	4	6	8	18	19	21	23	24	25			
	Dac		comp	-30	-29	-27	-26	-25	-26	-14	-13	-11	-9	-8	-7	6	6	7	8	8	9			
Low yield gap	CC impact: Org		% reduction in food-competing feed	-11	-8	-6	-3	1	4	8	11	14	18	22	25	30	33	36	38	42	44			
d g	8	50	n in	-25	-24	-22	-20	-18	-15	-9	-8	-5	-3	0	3	10	12	13	15	17	19			
ielo	0	50	ductio	-35	-33	-32	-30	-29	-27	-19	-18	-16	-15	-13	-11	-1	0	0	1	2	3			
۲ ک	>		% re					·0/		21	23	25	26	28	30	46	46	45	45	45	45			
2	ino;	%)					C	)%		2	3	4	5	6	7	25	24	23	22	21	20			
	v	lon								-9	-8	-8	-8	-8	-8	12	10	8	7	5	4			
	)rg	uct								14	16	18	19	21	24	39	38	38	38	38	38			
	C C	fed					25	5%		-4	-3	-2	-1	0	1	18	16	15	14	13	13			
	oac	ge I								-14	-14	-14	-14	-13	-13	6	4	2	0	-1	-3			
	CC impact: Org < Conv	Wastage reduction (%)								8	9	11	12	14	16	30	30	30	30	30	30			
	8	Va					<b>F</b> 0	0/		-9	-8	-8	-7	-6	-5	10	9	8	8	8	7			
	0	_					50	)%		-19	-19	-19	-19	-19	-19	-1	-3	-4	-6	-7	-8			

Supplementary Figure 2: Cropland area change with low yield gaps assumed

Percentage change in cropland areas with respect to the reference scenario (0% organic agriculture, no changes in livestock feed and food waste). Calories are kept constant for all scenarios. Low yield gaps<sup>9</sup>; scenarios differ in organic shares (0-100%); impacts of climate change on yields (low, medium, high; lower impacts for organic than conventional agriculture); food-competing feed reductions (0, 50, 100% reduced from the levels in the reference scenario) and wastage reduction (0,25,50% with respect to the reference scenario). Colour code for the relation to reference scenario value that is displayed in dotted grey: >+5%: red, <-5% blue, between -5% and +5% yellow; in the reference scenario, cropland areas are 6% higher than in the baseline today.

CC impa	cts on y	ro				3	med	lium					high	ı						
	% or	ganic	0	20	40	60	80	100				_	_		_			_		
>	0	100	25	21	15	10	4	-3	23	19	14	8	3	-3	21	16	12	7	1	-4
Conv	0	50	20	16	12	7	2	-4	18	14	10	6	1	-4	17	13	9	4	0	-5
0		0	15	11	7	3	-1	-5	13	10	7	3	-1	-5	12	9	5	2	-2	-6
lig	>	feed	23	19	14	8	2	-4	21	17	12	7	1	-4	19	15	10	5	0	-5
t: O	25	eting	18	14	10	6	1	-5	17	13	9	5	0	-5	15	11	7	3	-1	-5
Dac		comp	13	10	6	2	-2	-6	12	9	5	2	-2	-6	11	8	4	1	-3	-6
High yield gap Conv CC impact: Org	•	% reduction in food-competing feed	21	17	12	7	1	-5	19	15	10	5	0	-6	17	13	9	4	-1	-6
ရ ရ	50	n in	16	12	8	4	0	-6	15	11	7	3	-1	-6	14	10	6	2	-2	-6
iel	50	ductic	11	8	5	1	-3	-7	10	7	4	1	-3	-7	10	7	3	0	-3	-7
ч Ч		% re				~			23	19	14	8	3	-3	21	16	12	7	2	-4
ligi	%)					C	)%		18	14	10	6	1	-4	17	13	9	5	0	-4
T O	ion								13	10	6	3	-1	-5	12	9	5	2	-2	-5
lrg	nct (								21	17	12	7	2	-4	19	15	10	5	0	-5
t: C	led					25	5%		17	13	9	5	0	-5	15	11	7	3	-1	-5
oac	ge								12	9	5	2	-2	-6	11	8	4	1	-3	-6
High CC impact: Org < Conv	Wastage reduction (%)					19	15	10	5	0	-5	17	13	9	4	-1	-6			
g	S S 50%								15	11	7	3	-1	-5	14	10	6	2	-1	-6
0									10	7	4	1	-3	-7	10	7	3	0	-3	-7

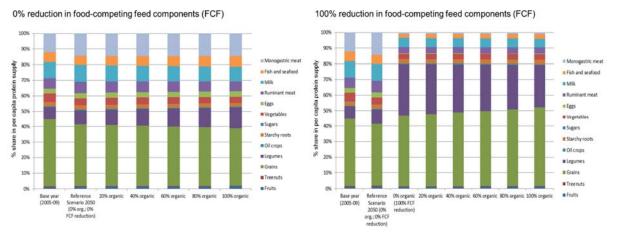
#### Supplementary Figure 3: Nitrogen balance with high yield gaps assumed

*N-surplus* (positive values) or deficit (negative values) in kg N/ha. Calories are kept constant for all scenarios. High yield gaps<sup>10</sup>; scenarios differ in organic shares (0-100%); climate change impacts (low, medium, high; lower impacts for organic than conventional agriculture); food-competing feed reductions (0, 50, 100% reduced from the levels in the reference scenario) and wastage reduction (0,25,50% with respect to the reference scenario). Colour code for the relation to reference scenario values (0% organic agriculture, no changes in livestock feed and food waste): >10kg/ha: red (unsustainably high), between 10kg/ha and 5kg/ha blue (optimum, reduction from current average surplus by 60-80%<sup>31,32</sup>), between 4kg/ha and -2kg/ha yellow (critical, rather low), <-2kg/ha red (deficit).

CC ir	npacts	s on y	yields	8		ze						med	lium					high	ı		
		% or	qanic	0	20	40	-	80	100	22	10	10	6			21	10			0	-
	Z	0	100		20	14	7	1	-6	32	18	12	6	0	-6	21	16	11	6	0	-5
	Conv		50	20	15	10	5	-1	-6	18	14	9	4	-1	-6	17	13	8	4	0	-5
	11		0	15	10	6	2	-3	-8	13	10	6	2	-3	-7	12	9	5	1	-2	-6
	)rg		feed	23	18	12	6	-1	-8	21	16	11	5	-1	-7	19	14	10	5	-1	-6
	t: O	25	eting	18	13	9	4	-2	-7	17	12	8	3	-2	-7	15	11	7	3	-1	-6
	ac		dmo	13	9	5	1	-4	-8	12	8	4	1	-3	-8	11	8	4	1	-3	-7
ap	CC impact: Org		o-poo	21	16	10	10	-2	-9	19	14	9	4	-2	-8	17	13	8	3	-2	-7
g	Ö		n in f	16	12	7	2	-3	-8	15	11	6	2	-3	-8	14	10	6	2	-2	-7
Low yield gap	0	50	% reduction in food-competing feed	11	7	4	0	-5	-9	10	7	3	0	-4	-8	10	6	3	0	-4	-7
į			6 red							23	18	12	6	0	-6	21	16	11	5	0	-6
Š	N	(%	6				C	)%		18	14	9	4	-1	-6	17	10	8	3	-1	
Ц	ပိ	Ľ																-			-6
	V	l;;								13	9	5	1	-3	-7	12	9	5	1	-3	-7
	Drg	n								21	16	10	5	-1	-7	19	14	9	4	-2	-7
	;; ;;	e l					25	5%		17	12	8	3	-2	-7	15	11	7	2	-2	-7
	pac	ge							12	8	4	0	-4	-8	11	7	4	0	-4	-8	
	CC impact: Org < Conv	Wastage reduction (%)								19	14	9	3	-3	-9	17	13	8	2	-3	-8
	Ŋ	S S								15	11	6	2	-3	-8	14	9	5	1	-3	-7
	0	> 50%								10	7	3	-1	-5	-9	10	6	3	-1	-5	-8

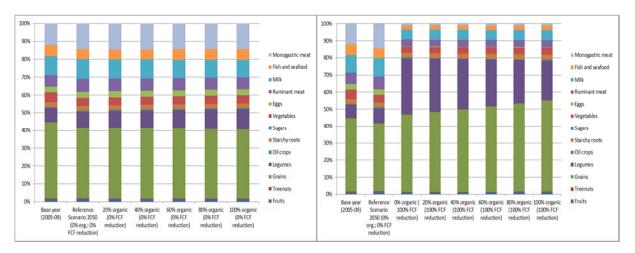
Supplementary Figure 4: Nitrogen balance with low yield gaps assumed

*N*-surplus (positive values) or deficit (negative values) in kg N/ha. Calories are kept constant for all scenarios. Low yield gaps<sup>9</sup>; scenarios differ in organic shares (0-100%); climate change impacts (low, medium, high; lower impacts for organic than conventional agriculture); food-competing feed reductions (0, 50, 100% reduced from the levels in the reference scenario) and wastage reduction (0,25,50% with respect to the reference scenario). Colour code for the relation to reference scenario values (0% organic agriculture, no changes in livestock feed and food waste): >10kg/ha: red (unsustainably high), between 10kg/ha and 5kg/ha blue (optimum, reduction from current average surplus by 60-80%<sup>31,32</sup>), between 4kg/ha and -2kg/ha yellow (critical, rather low), <-2kg/ha red (deficit).



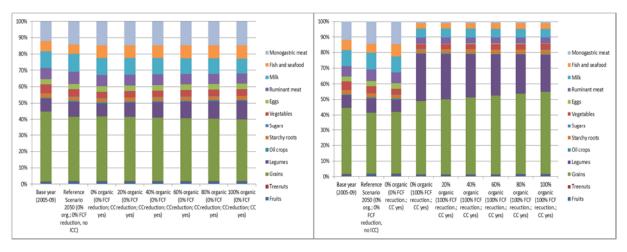
Supplementary Figure 5: Dietary composition under high yield gaps and without impact of climate change on yields

Dietary composition as shares of various commodity groups in per capita protein supply (before subtracting wastage) without (left) and with (right) reduction of food-competing feed; no climate change impacts; high yield gaps<sup>10</sup>. All scenarios provide the same amount of calories (no wastage reduction).



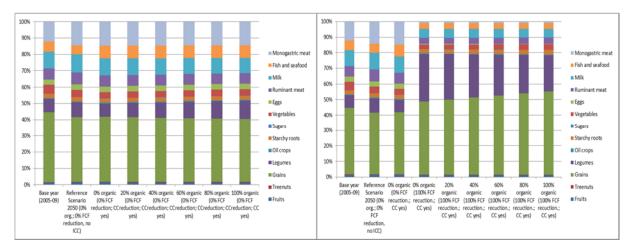
## Supplementary Figure 6: Dietary composition under low yield gaps and without impact of climate change on yields

Dietary composition as shares of various commodity groups in per capita protein supply (before subtracting wastage) without (left) and with (right) reduction of food-competing feed; no climate change impacts; low yield gaps<sup>9</sup>. All scenarios provide the same amount of calories (no wastage reduction).



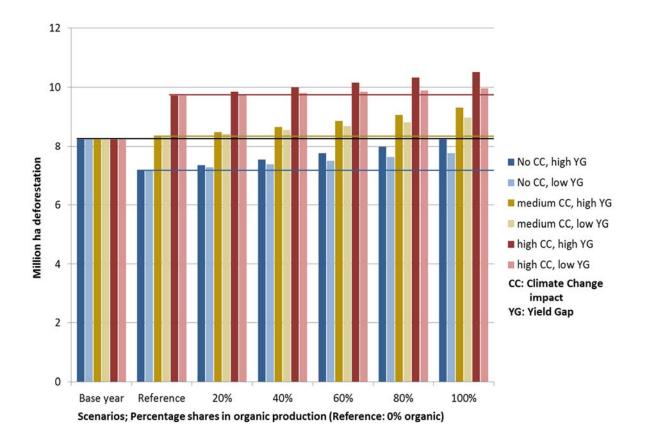
Supplementary Figure 7: Dietary composition under high yield gaps and with impact of climate change on yields

Dietary composition as shares of various commodity groups in per capita protein supply (before subtracting wastage) without (left) and with (right) reduction of food-competing feed; high climate change impacts; high yield gaps<sup>10</sup>. All scenarios provide the same amount of calories (no wastage reduction).



Supplementary Figure 8: Dietary composition under low yield gaps and with impact of climate change on yields

Dietary composition as shares of various commodity groups in per capita protein supply (before subtracting wastage) without (left) and with (right) reduction of food-competing feed; high climate change impacts; low yield gaps<sup>9</sup>. All scenarios provide the same amount of calories (no wastage reduction).



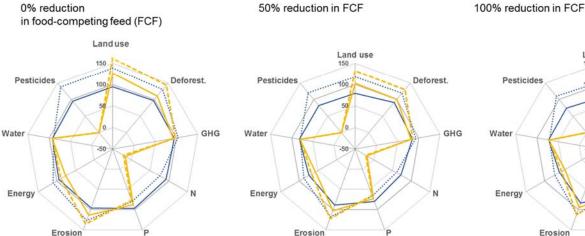
#### Supplementary Figure 9: Deforestation

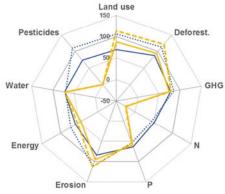
Deforestation (million ha) for the base year, the reference scenarios (0% organic) and scenarios with increasing percentages of organic production. Displays scenarios with low and high yield gaps<sup>9,10</sup> without and with medium and full impacts of climate change on yields (no / medium / high CC).

#### 0% food wastage reduction 0% reduction 50% reduction in FCF 100% reduction in FCF in food-competing feed (FCF) Landuse Land use Land use 150 150 150 Pesticides Deforest. Pesticides Deforest. Pesticides Deforest. 100 100 5 50 0 0 Water GHG Water GHG Water GHG -50 50 Energy Energy Energy Erosion Frosion 'n Erosion

The numbers on the axis indicate % impact, rel. to the reference scenario (which is represented by the thicker grey line at 100%)

#### 25% food wastage reduction

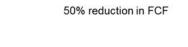




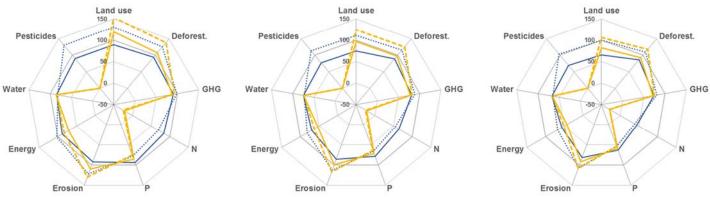
The numbers on the axis indicate % impact, rel. to the reference scenario (which is represented by the thicker grey line at 100%)

50% food wastage reduction

0% reduction in food-competing feed (FCF)



100% reduction in FCF



The numbers on the axis indicate % impact, rel. to the reference scenario (which is represented by the thicker grey line at 100%)

# Supplementary Figure 10: Year 2050 relative environmental impacts of a full conversion to organic agriculture in combination with complementary food systems strategies under high yield gaps

Percentage of environmental impacts with respect to the reference scenario (i.e. 0% organic agriculture, no changes in livestock feed and food waste; dark grey line); Calories are kept constant for all scenarios without food wastage reduction; high yield gaps<sup>10</sup> assumed; the lines show the range of impacts for 0% (dark blue) to 100% organic shares (yellow) under the respective reduction of food-competing feed and wastage as indicated for each panel; the solid lines indicate environmental impacts without impacts of climate change on yields, the dotted lines indicate environmental impacts with ICC. The thicker solid grey gridline indicates the 100% level, i.e. the reference scenario. Food-competing feed (FCF) use is at the levels of the reference scenario on the left (i.e. 0% reduction in FCF) and changes towards zero FCF use to the right (i.e. 100% reduction in FCF); wastage reduction changes from 0% (top panel) to 50% (bottom). Indicators displayed: cropland use, deforestation, GHG emissions (incl. deforestation, organic soils), N- and P-surplus, water use, non-renewable energy use, soil erosion, pesticide use.



The numbers on the axis indicate % impact, rel. to the reference scenario (which is represented by the thicker grey line at 100%)

GHG

#### 50% food wastage reduction

50

-50

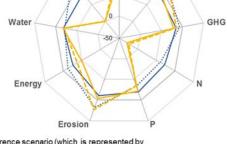
Water

Energy

0% reduction

Erosion

in food-competing feed (FCF)



50% reduction in FCF

50

100% reduction in FCF

Pesticides

Water

Energy

Erosion

Land use

150

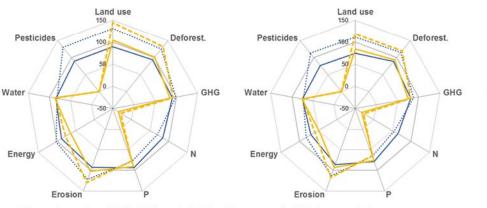
100

-50

Erosion

Water

Energy



The numbers on the axis indicate % impact, rel. to the reference scenario (which is represented by the thicker grey line at 100%)

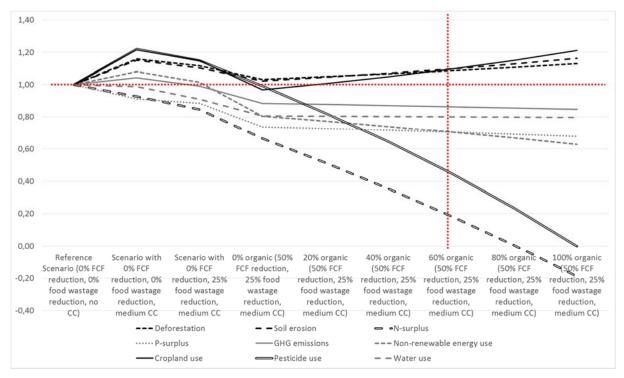
GHG

Deforest.

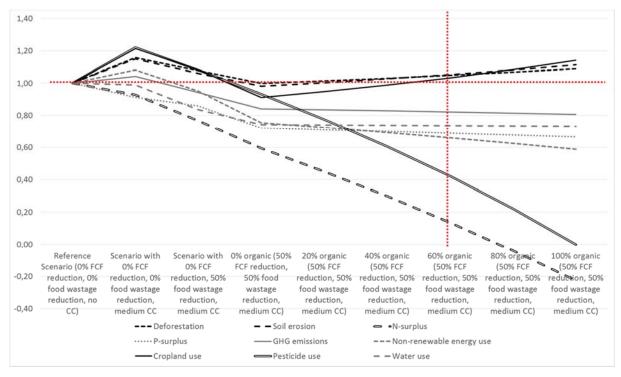
GHG

# Supplementary Figure 11: Year 2050 relative environmental impacts of a full conversion to organic agriculture in combination with complementary food systems strategies under low yield gaps

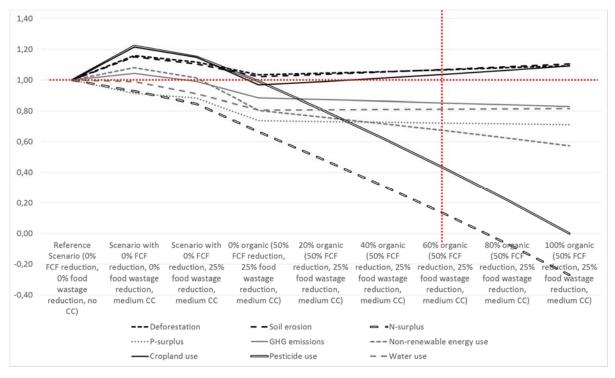
Percentage of environmental impacts with respect to the reference scenario (i.e. 0% organic agriculture, no changes in livestock feed and food waste; dark grey line); Calories are kept constant for all scenarios without food wastage reduction; low yield gaps<sup>9</sup> assumed; the lines show the range of impacts for 0% (dark blue) to 100% organic shares (yellow) under the respective reduction of food-competing feed and wastage as indicated for each panel; the solid lines indicate environmental impacts without impacts of CC. The thicker solid grey gridline indicates the 100% level, i.e. the reference scenario. Food-competing feed (FCF) use is at the levels of the reference scenario on the left (i.e. 0% reduction in FCF) and changes towards zero FCF use to the right (i.e. 100% reduction in FCF); wastage reduction is displayed in the three panels, from 0% (top) to 50% (bottom).The indicators are cropland use, deforestation, GHG emissions (incl. deforestation and organic soils), N- and P-surplus, water use, non-renewable energy use, soil erosion and pesticide use.



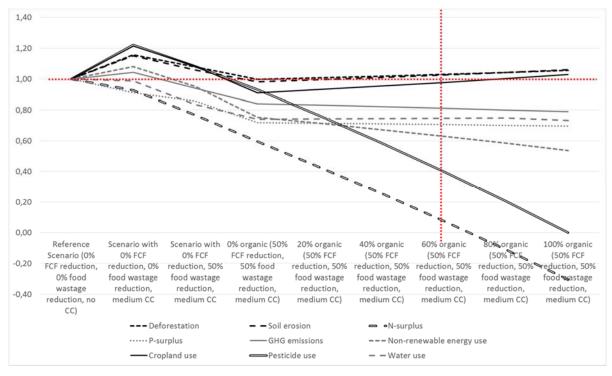
Supplementary Figure 12: Relative change of environmental impacts with respect to the reference scenario for increasing shares of organic production. The dotted red horizontal line indicates the level for the reference scenario, the dotted red vertical line indicates the values for 60% conversion to organic agriculture. Calories are kept constant for all scenarios without food wastage reduction; high yield gaps, 50% food-competing feed (FCF) reduction, 25% food wastage reduction and intermediate impact of CC assumed; to the left, for comparison, the scenarios without food-competing feed and food wastage reduction but CC impact, as well as no food-competing feed reduction, 25% food wastage reduction and CC impact are displayed.



Supplementary Figure 13: Relative change of environmental impacts with respect to the reference scenario for increasing shares of organic production. The dotted red horizontal line indicates the level for the reference scenario, the dotted red vertical line indicates the values for 60% conversion to organic agriculture. Calories are kept constant for all scenarios without food wastage reduction; high yield gaps, 50% food-competing feed (FCF) reduction, 50% food wastage reduction and intermediate impact of CC assumed; to the left, for comparison, the scenarios without food-competing feed and food wastage reduction but CC impact, as well as no food-competing feed reduction, 50% food wastage reduction and CC impact are displayed.



Supplementary Figure 14: Relative change of environmental impacts with respect to the reference scenario for increasing shares of organic production. The dotted red horizontal line indicates the level for the reference scenario, the dotted red vertical line indicates the values for 60% conversion to organic agriculture. Calories are kept constant for all scenarios without food wastage reduction; low yield gaps, 50% food-competing feed (FCF) reduction, 25% food wastage reduction and intermediate impact of CC assumed; to the left, for comparison, the scenarios without food-competing feed and food wastage reduction but CC impact, as well as no food-competing feed reduction, 25% food wastage reduction and CC impact are displayed.



Supplementary Figure 15: Relative change of environmental impacts with respect to the reference scenario for increasing shares of organic production. The dotted red horizontal line indicates the level for the reference scenario, the dotted red vertical line indicates the values for 60% conversion to organic agriculture. Calories are kept constant for all scenarios without food wastage reduction; low yield gaps, 50% food-competing feed (FCF) reduction, 50% food wastage reduction and intermediate impact of CC assumed; to the left, for comparison, the scenarios without food-competing feed and food wastage reduction but CC impact, as well as no food-competing feed reduction, 50% food wastage reduction and CC impact are displayed.