LCA of French and Brazilian broiler poultry production systems

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Introduction

- This study is a comparison of environmental burdens of four scenarios for poultry production, two from Brazil and two from France;

The two Brazilian scenarios contrasts large and small scale production systems;

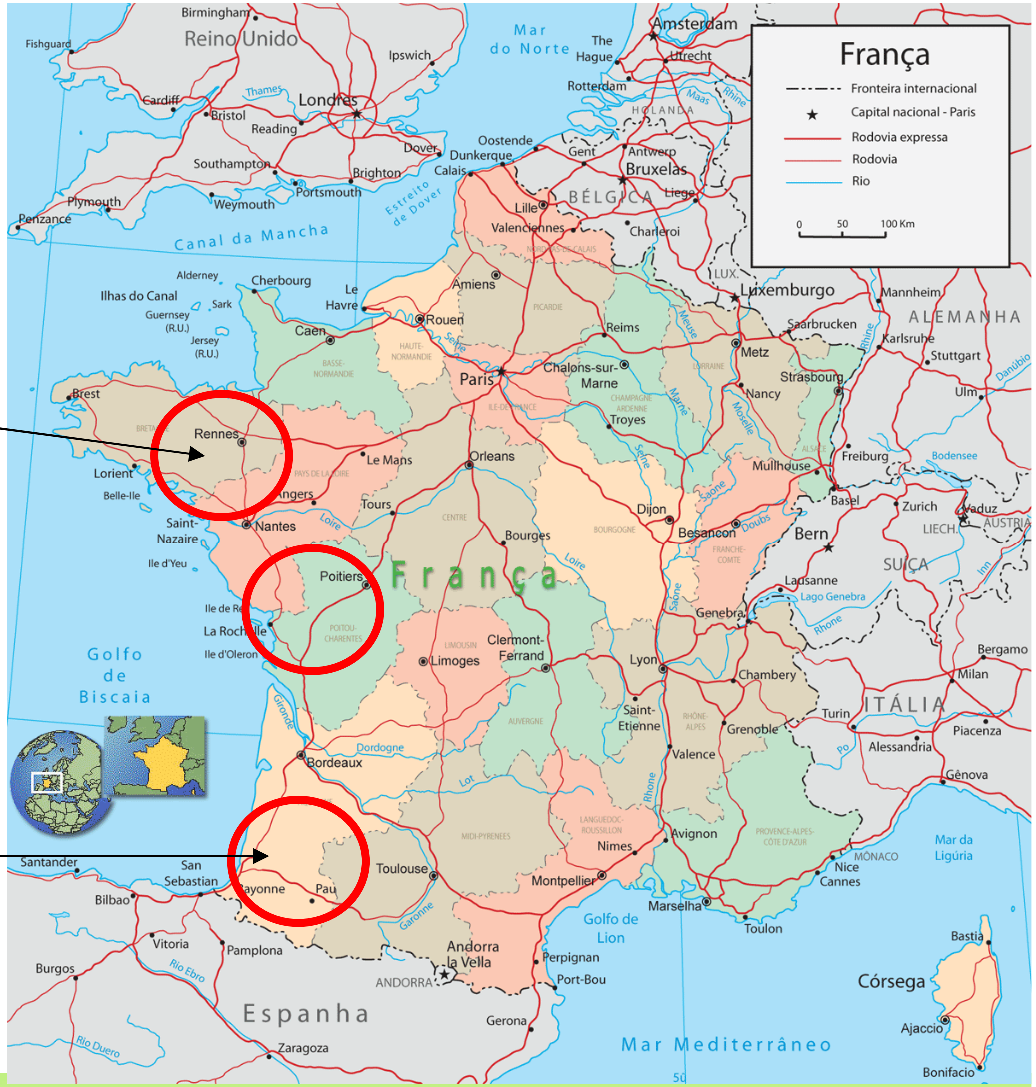
The two French scenarios contrasts high (standard) and low (label rouge) intensity production systems;

Methodology

Areas of study: France

Standard System (ST)

Label Rouge (LR)

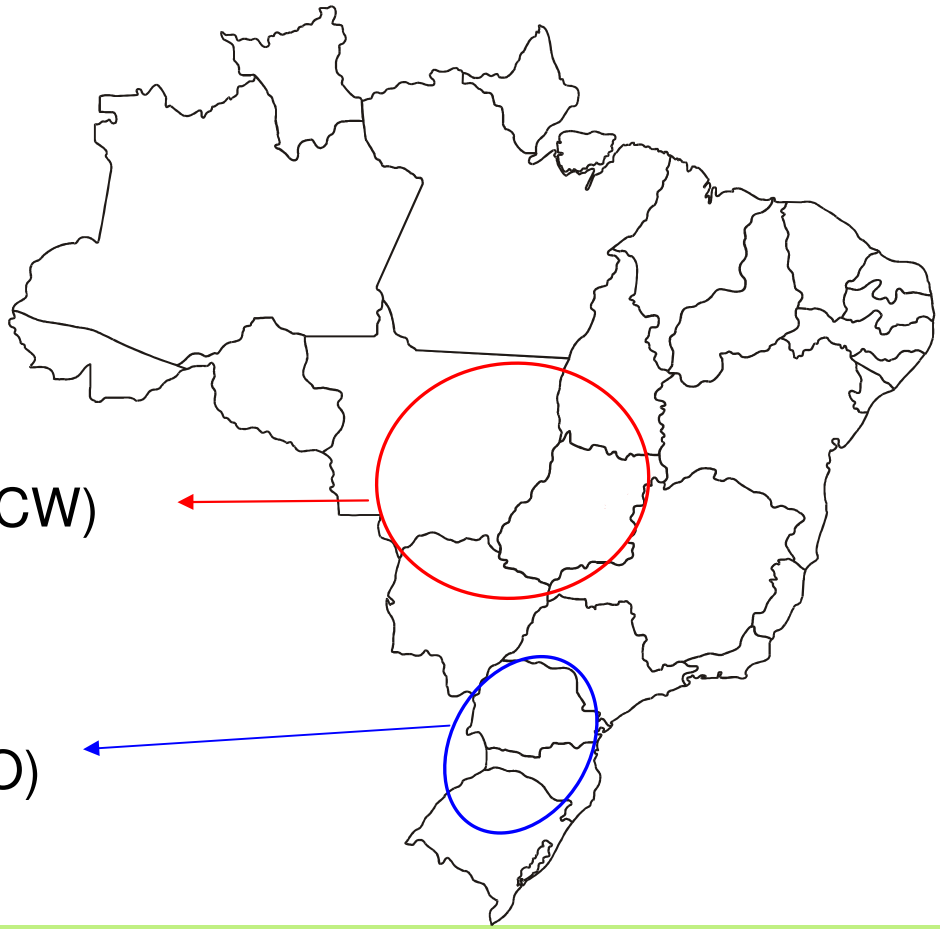


Methodology

Areas of study:
Brazil

Large-scale Centre-West (CW)

Small-scale South (SO)



Methodology

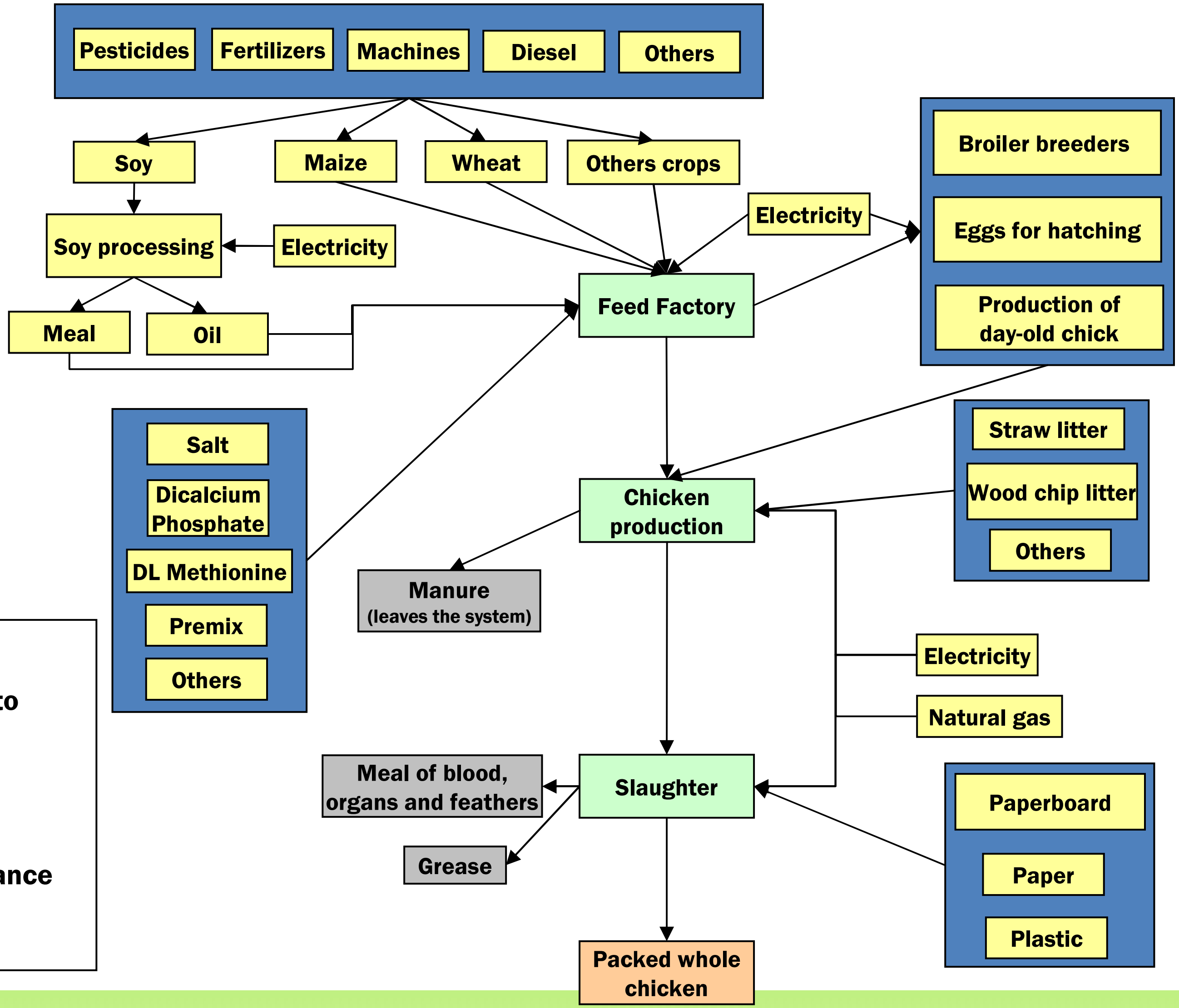
- The characterisation method was the CML 2001-(baseline) +:

Land Occupation

Total Cumulative Energy Demand

- Functional unit: 1 ton of chicken cooled and packaged at the slaughterhouse gate;

Methodology



Notes:

- transportation was taken into account among all stages.

- only the main processes are represented.

- buildings and their maintenance were not considered in the calculations.

Methodology

Technical indicators of four poultry systems

Indicator	LR	ST	SO	CW
Rearing time (days)	89	40	42	42
Final weight (kg)	2.26	1.92	2.48	2.40
Density (m^2)	10.9	22	11.7	15
Mortality (%)	3.1	4.1	4.4	4.2
Feed conversion (kg/kg)	3.09	1.87	1.86	1.89
Batches per year	3.1	6.0	6.4	6

Source: LR and ST systems – ITAVI (2003); SO system - (Martins, Talamini, and Souza 2007); CW system - (Carfantan 2007).

Methodology

Pollutants emission approach:

- Emissions from litter manure in the chicken house:

CH_4 according to GESTIM (2009)
Emission factor (kg CH_4 per head)
Egg hens : 0,053
pullet : 0,013

NH_3 according to Gac et al. (2007)
Emission factor by N
Excreted/head/year: 30,4 %

N_2O according to GESTIM (2009)
Emission factor (kg N_2O per head)
Egg hens : 0,0164
pullet : 0,00024
chicken : 0,128 g of N_2O per kg LW

Methodology

Pollutants emission approach:

- Emissions from litter manure on **storage:**

CH_4 according to GESTIM (2009)
Emission factor (kg CH_4 per head)
hens : 0,1
pullet : 0,04

NH_3 according Gac et al. (2007)
Emission factor
N excreted/head/year : 9,5 %

N_2O according to GESTIM (2009)
Emission factor (kg N_2O per head)
hens : 0,0003
pullet : 0,0006
chicken : 0,262 g of N_2O per kg LW

Methodology

Pollutants emission approach:

- Emissions from manure **out side of chicken house:**

CH_4 according to et al. (2007)
Emission factor
CH_4 excreted/head/year: 0,04 %

N_2O according to GESTIM (2009)
Emission factor
pullet : 0,0019 g of N_2O per kg LW

NH_3 according to Gac et al. (2007)
Emission factor
N excreted/head/year : 10,7 %

Methodology

Estimated gaseous emissions for animal production stage, in kg of gas per ton of live weight poultry

Emission	LR	ST	SO	CW
CH_4	5.79	6.95	5.24	5.42
N_2O	0.42	0.51	0.38	0.40
NH_3	21.48	11.28	8.51	8.79

Déforestation (Prudêncio da Silva et al., sous presse)

- Recent studies show that soybean crops are still grown on recently deforested areas, but to a lesser degree than previously (ABIOVE, 2008). We therefore used a different way to estimate land transformation for soybean production, based on data for Mato Grosso, which, over the 2005-2008 period, represented 87% of the soybean area and 31% of the deforestation in the Legal Amazon region.
- According to Morton et al. (2006), over the 2001-2005 period 14% of deforested area in Mato Grosso was transformed to cropland for soy production. Assuming that this holds for the 2005-2008 period, and using recent data on deforested surfaces in the Legal Amazon rainforest (PRODES, 2009), we estimated for each year of this period the newly deforested area used for soy production, and expressed this as a percentage of the total soy area.
- For the states concerned by the CW scenario we found an average value of 1% for the 2005-2008 period. We therefore assumed for the CW scenario that 1% of land used for soy was transformed from rainforest. To estimate land transformation from cerrado for soybeans, we extrapolated data from Morton et al. (2006) for 2001-2004 in Mato Grosso to other states were cerrado bioma occurs, yielding a value of 3.4% for land transformation from cerrado for soy in the CW scenario. In the states concerned by the SO scenario tropical rainforest and cerrado do not exist; we assumed 0% of land transformation from rainforest and cerrado.

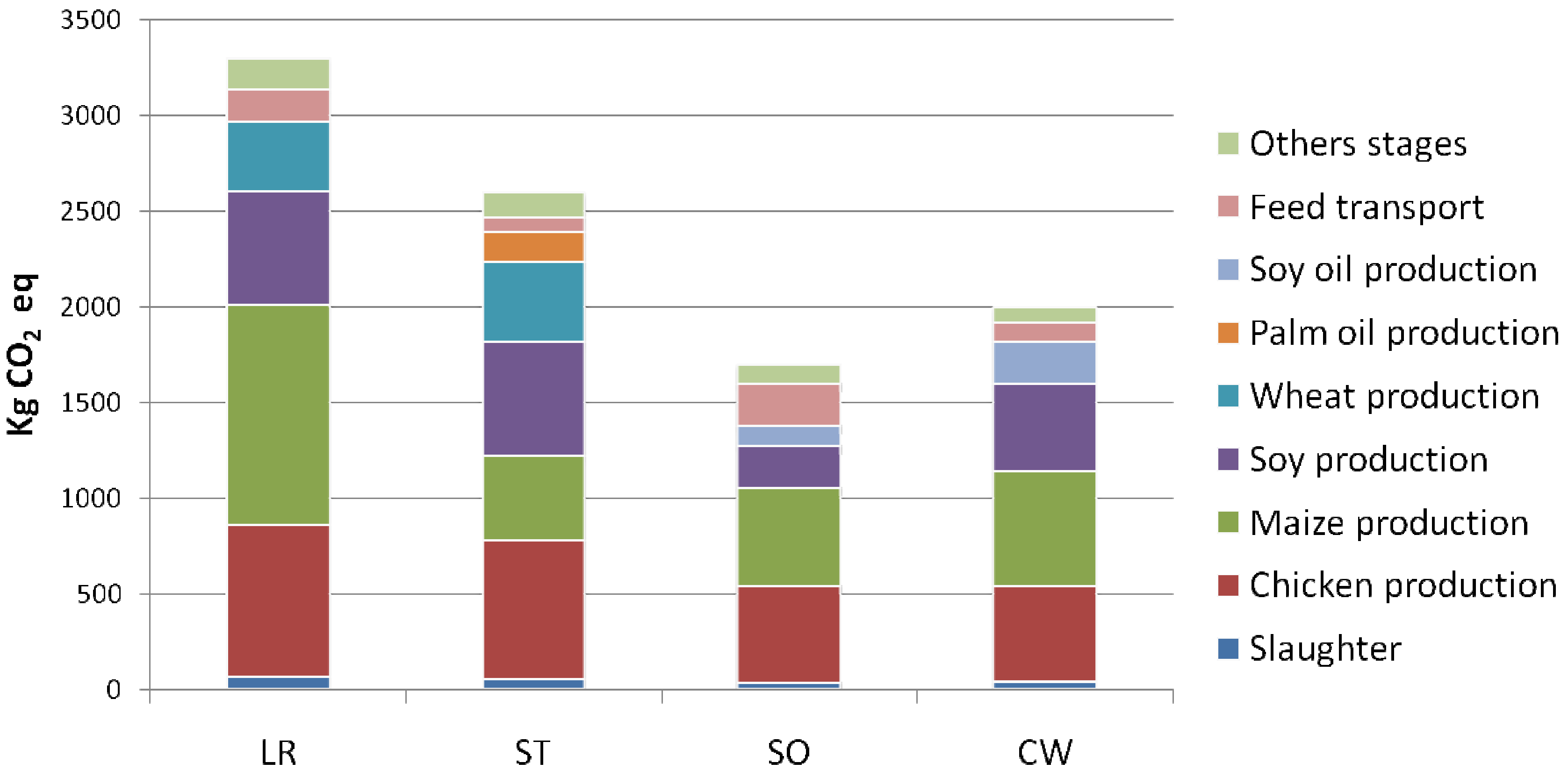
Results and discussion

Environmental impacts for 1 ton of chicken cooled and packaged produced in Southwest (LR) and West of France (ST), Center West (CW) and South (SO) of Brazil

Impact category	Unit	LR	ST	SO	CW
Acidification	kg SO_2 eq	70.6	41.1	45.1	42.4
Eutrophication	kg PO_4 eq	30.2	21.8	18.4	17.7
Climate change	kg CO_2 eq	3 311	2 560	1 744	2 006
Terrestrial ecotoxicity	kg 1,4-DB eq	15.0	9.3	9.2	10.1
Land occupation	m^2a	6 617	4 482	3 603	3 535
Cumalative energy demand	MJ	59 698	35 238	27 135	29 494

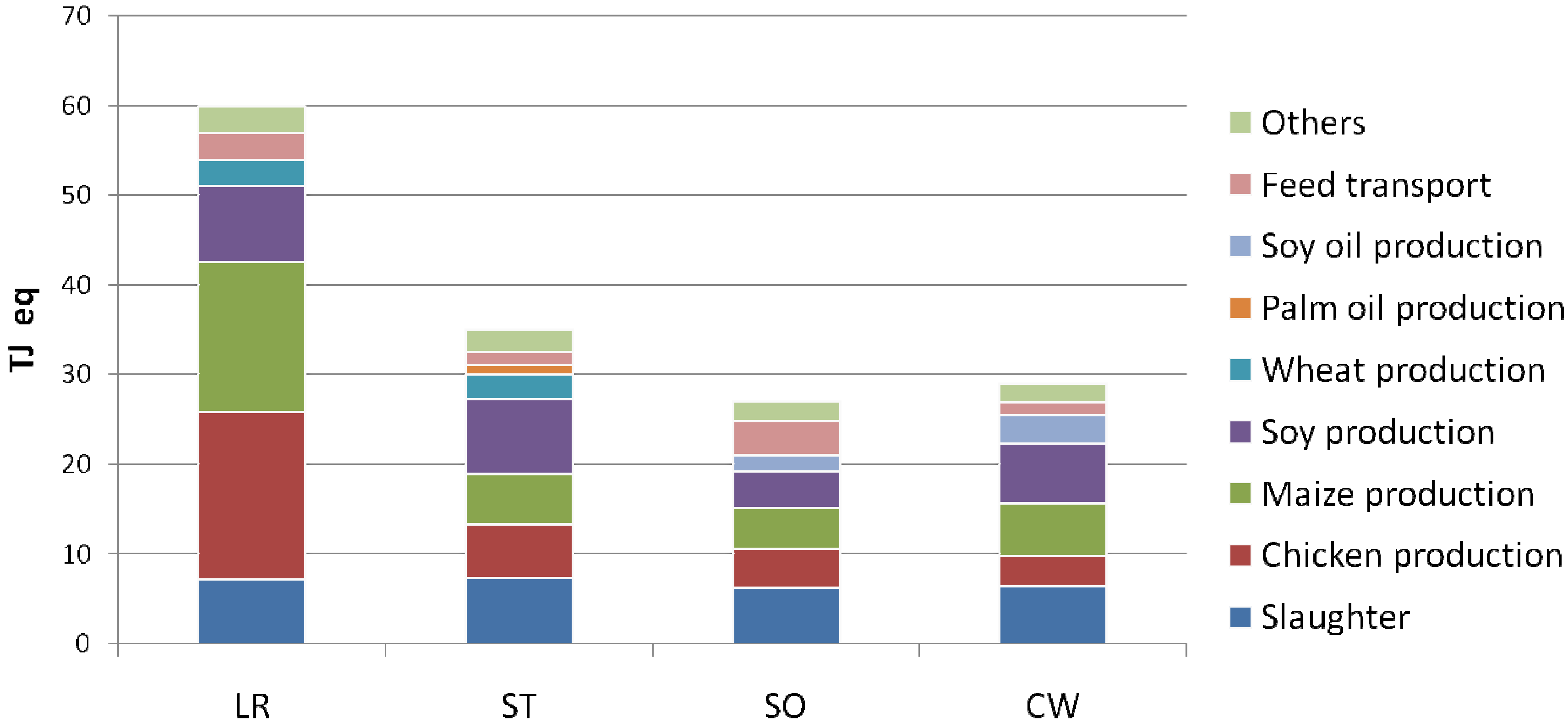
Results and discussion

Main contributions from some stages for **climate change** for studied systems SouthWest of France (LR – Label Rouge), West of France (ST - standard), South (SO) and Center West (CW) of Brazil.



Results and discussion

Main contributions from some stages for **cumulative energy demand** for studied systems SouthWest of France (LR – Label Rouge), West of France (ST standard), South (SO) and Center West (CW) of Brazil.



Results and discussion

Main contributions from some stages for **climate change** for studied systems SouthWest of France (LR – Label Rouge), West of France (ST - standard), South (SO) and Center West (CW) of Brazil.

	Contribution to climate change (%)			
Life Cycle Stage	LR	ST	SO	CW
Slaughter	2	2	2	2
Chicken production	24	28	30	25
Maize production	35	17	30	30
Soy production	18	23	13	23
Wheat production	11	16	-	-
Palm oil production	-	6	-	-
Soy oil production	-	-	6	11
Feed transport	5	3	13	5
Others stages	5	5	6	4

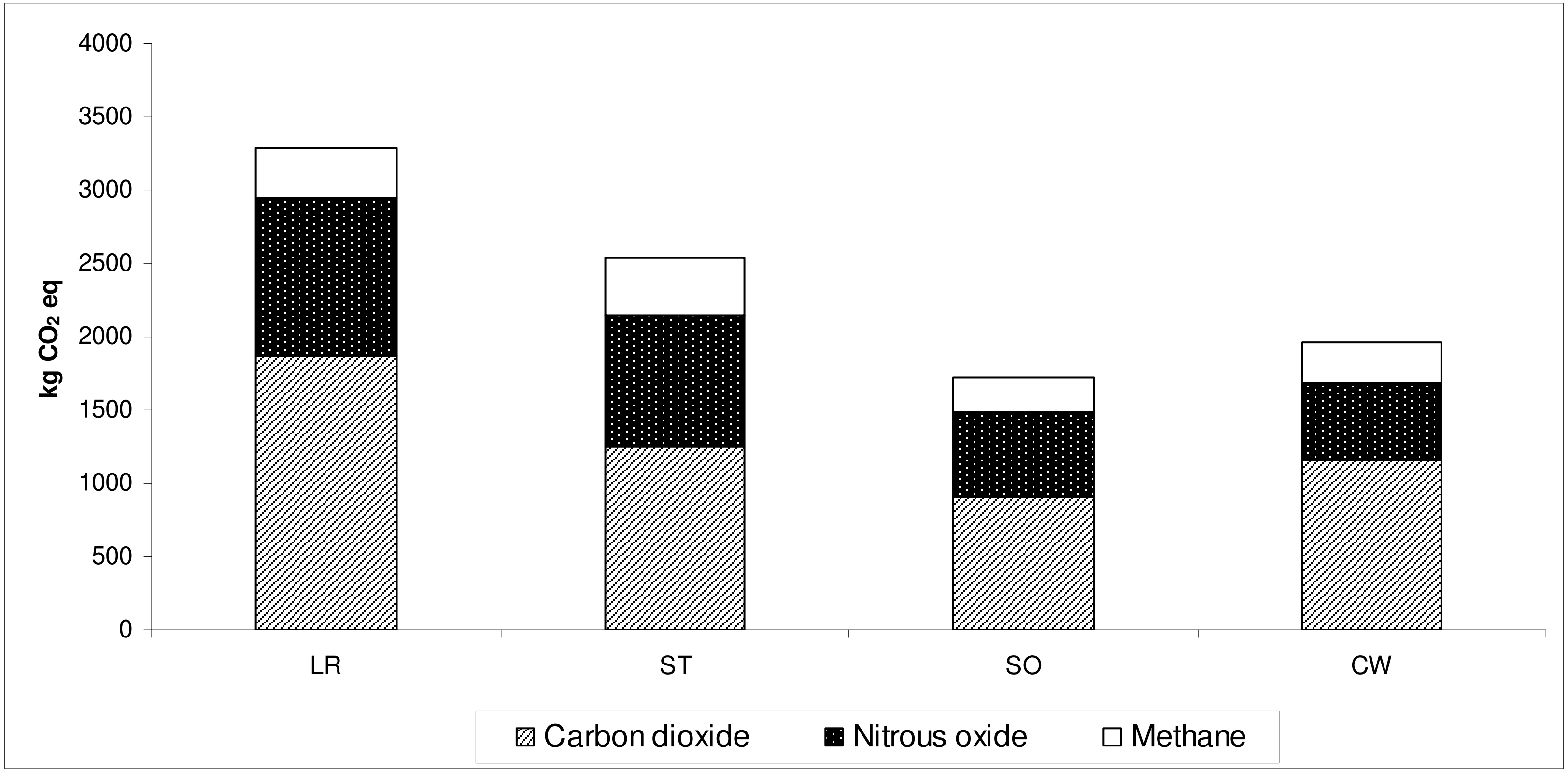
Results and discussion

Main contributions from some stages for **cumulative energy demand** for studied systems SouthWest of France (LR – Label Rouge), West of France (ST - standard), South (SO) and Center West (CW) of Brazil.

Life Cycle Stage	Contribution to cumulative energy demand (%)			
	LR	ST	SO	CW
Slaughter	12	21	23	22
Chicken production	31	17	16	12
Maize production	28	16	17	20
Soy production	14	24	15	23
Wheat production	5	8	-	-
Palm oil production		3	-	-
Soy oil production	-	-	7	11
Feed transport	5	4	14	5
Others	5	7	8	7

Results and discussion

Greenhouse gases contribution on climate change for 1 ton of chicken cooled and packaged produced in Southwest (LR) and West of France (ST), Center West (CW) and South (SO) of Brazil



Results and discussion

- About 95% of carbon dioxide emissions comes from the grain production stage due to the burning of fossil fuels and transport between several stages;

- Nitrous oxide also contributes significantly, coming about 72% from the grain production stage resulting from nitrate losses, but also from emissions in the chicken house, about 25%;

Conclusion

- The strong participation of the grain production stage on the environmental impacts of poultry production serves as a determinant factor associated with feed conversion rate of each system as well as the carcass yield at the slaughterhouse stage;

Conclusion

- At least for the impact categories studied, the Label Rouge system causes more environmental impacts than the others three systems which are variations of the standard way of production;

- Efforts to improve the feed conversion rate, carcass yield and to reduce the use of fossil fuels in the supply chain can help to improve the environmental performance of such poultry production scenarios;

Conclusion

Issues for improving the chicken production system:

- Ending deforestation (grain production);
- The improvement of transport logistics (grain, feed, and chicken);
- Optimization of fertilization and the use of farm machinery, to reduce climate change;
- Conservation practices to prevent soil erosion;
- Improved production techniques to increase yield;
- Integrated management of diseases and pests, to minimize the use of pesticides;

Acknowledgments

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