Comparison of Organic and Conventional Cropping System from Climate Change Perspective

Tek B. Sapkota[1], Daniele Antichi[1], Paola Belloni[2], Paolo Barberi[1] and Marco Mazzoncini[2]

[1]Sant Anna' School of Advanced Studies, Pisa
[2] Center of Agro-environmental Research, University of Pisa

UNIVERSITÀ DI PISA
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Agriculture as victim of climate change

Climate change has many consequences on agricultural production and productivity

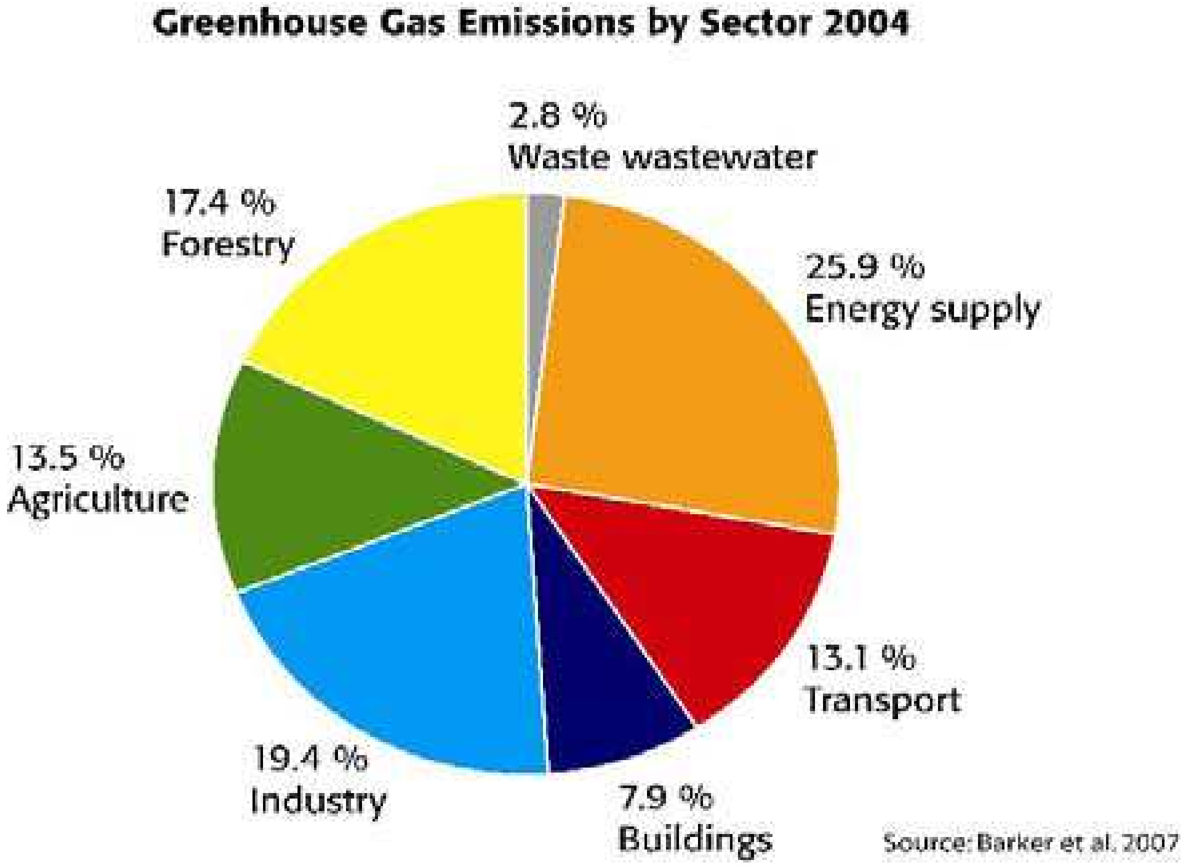
Drought

Flood

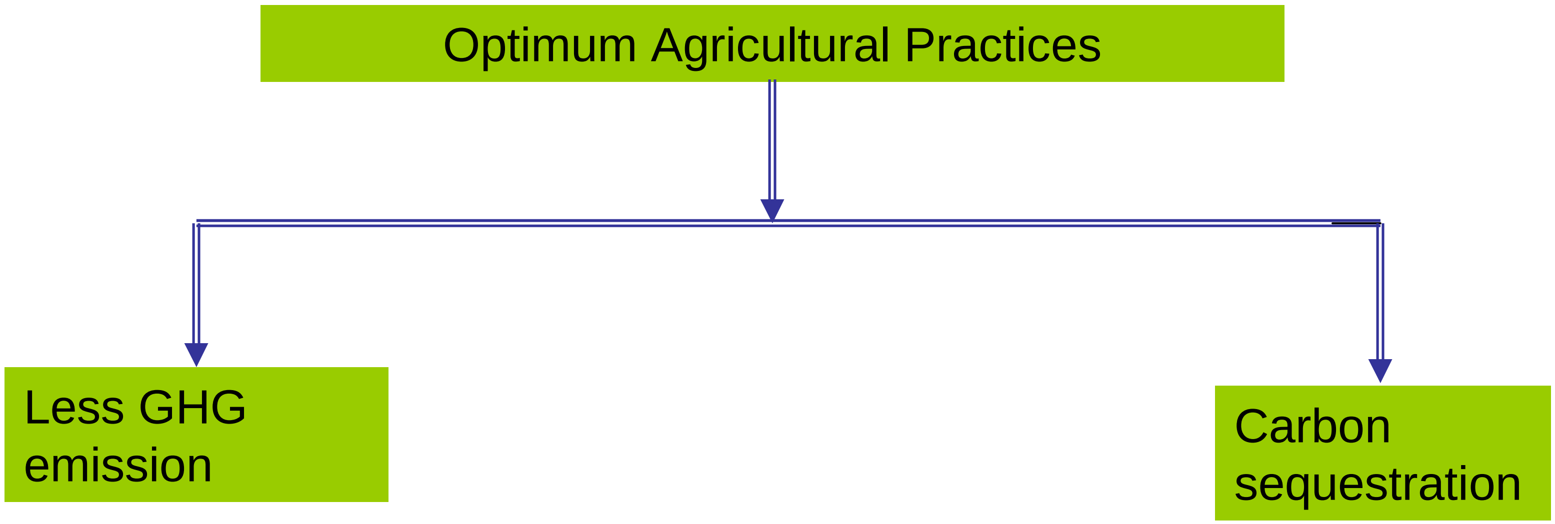
Pests outbreak

Sea level rise

Agriculture is also one of the causes of climate change



How can agriculture be made more climate friendly?



Mediterranean Arable System Comparison Trail (MASCOT)

Hypothesis

Organic agriculture is superior to its conventional counterpart economically, agronomically and environmentally

Objectives of this paper

- To evaluate and compare emissions of greenhouse gases from organic and conventional cropping systems
- To compare energy efficiency of two cropping systems
- To analyse total carbon balance and carbon sequestration potential of two cropping systems.

Where?

•Centre for Agri-environmental Research "E. Avanzi" (CIRAA), Pisa, Italy

System description

Parallel comparison of Organic and Conventional Production system

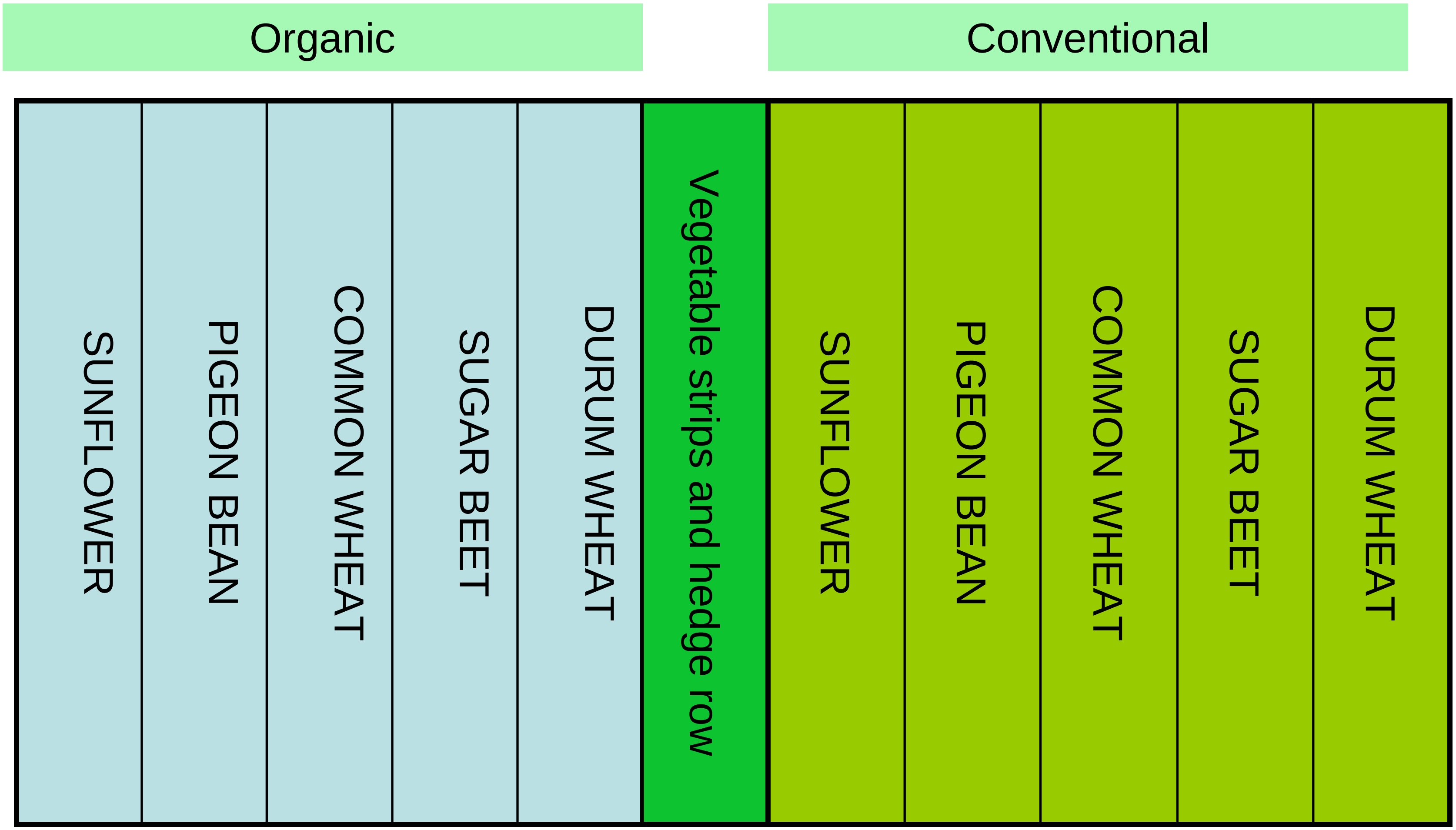


Figure: Showing one replication of field layout

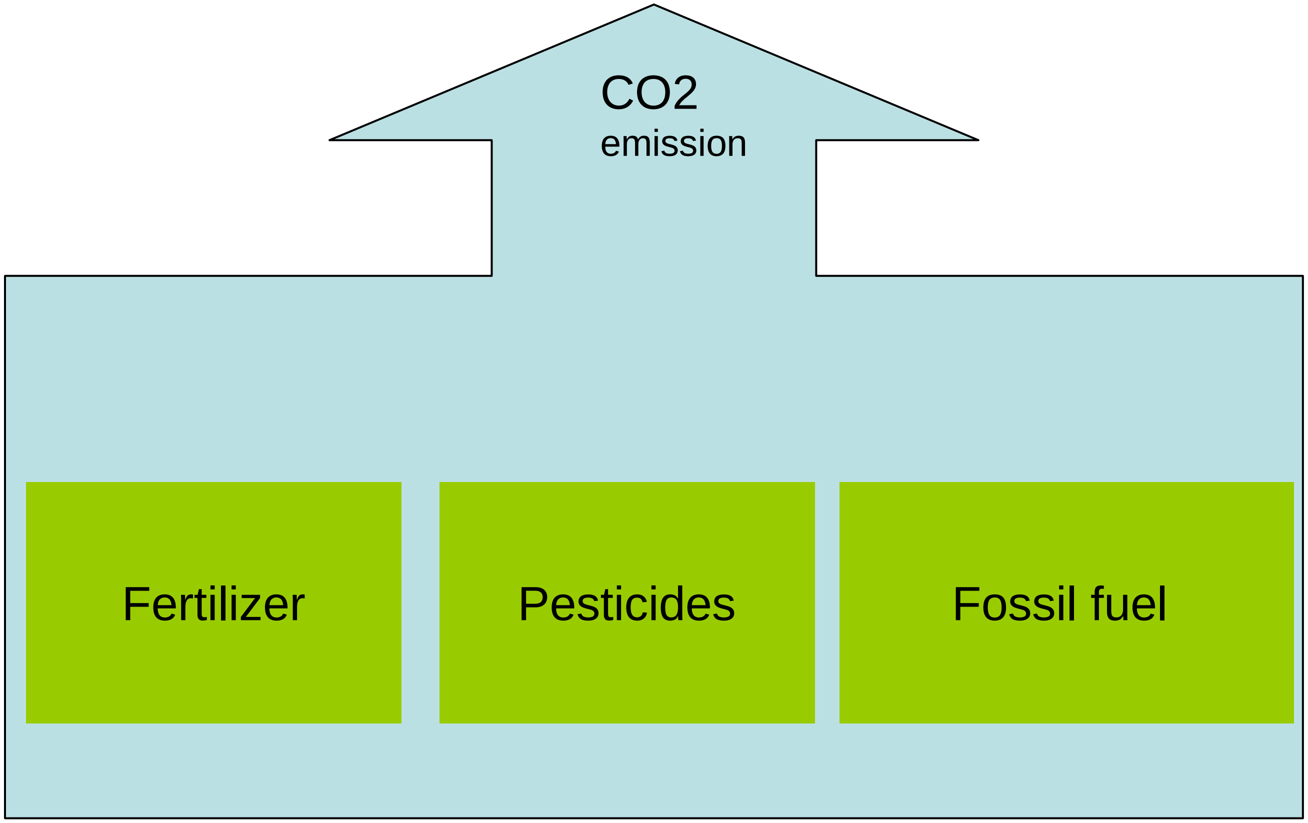
Aerial View of experimental site

Summary of Agronomic practices

Cultural practice	Sugar beet		Common wheat		Sunflower		Pigeon bean		Durum wheat	
	CS	**OS**	**CS**	**OS**	**CS**	**OS**	**CS**	**OS**	**CS**	**OS**
Main tillage (depth cm)	50	25	25	25	25	25	25		50	25
Fertilisation	Mineral	Organic	Mineral	Organic	Mineral	Organic	Mineral	None	Mineral	Organic
Fertilisation (kg ha^{-1})	162 N 138 P_2O_5 250 K_2O	30 N 30 P_2O_5 30 K_2O	156 N 92 P_2O_5 0 K_2O	30 N 30 P_2O_5 30 K_2O	128 N 96 P_2O_5 96 K_2O	30 N 30 P_2O_5 30 K_2O	0 N 69 P_2O_5 0 K_2O	-	156 N 92 P_2O_5 0 K_2O	30 N 30 P_2O_5 30 K_2O
Seed rate	18 seeds m^{-2}	18 seeds m^{-2}	200 kg ha^{-1}	200 kg ha^{-1}	8 seeds m^{-2}	8 seeds m^{-2}	200 kg ha^{-1}	200 kg ha^{-1}	230 kg ha^{-1}	230 kg ha^{-1}
Weed control	Pre-em + post-em	-	Post-em	ST H	Pre-em	Hoeing	None	STH	Post-em	STH
Residue management	Incorp.	Incorp.	Remove	Incorp.	Incorp.	Incorp.	Incorp.	Incorp.	Removed	Incorp.

Results

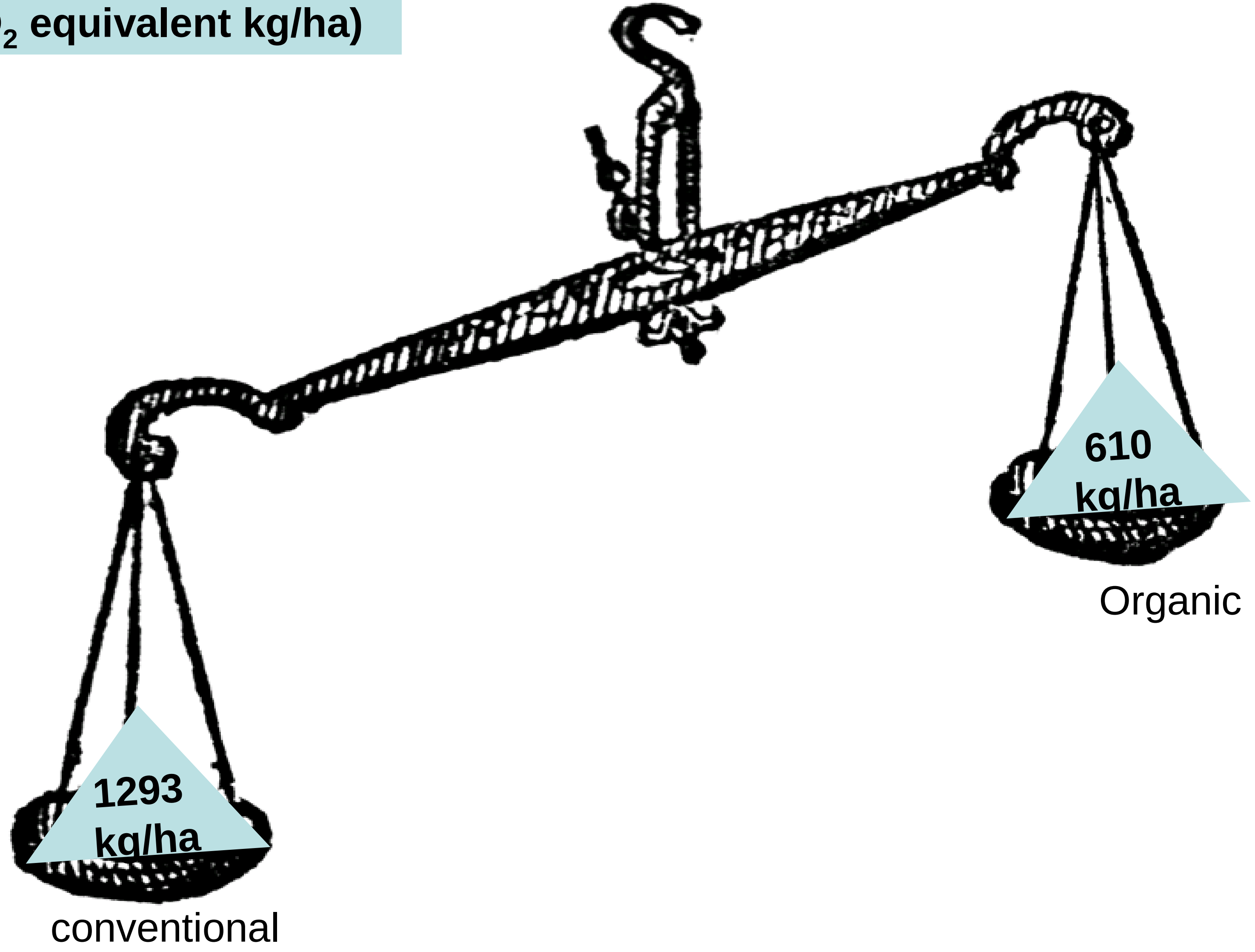
GHG emission



Total consumption of these resources ha^{-1} in each system was multiplied by the index of IPCC, American Petroleum Institute (for fossil fuel) and R lal, 2004 (for fertilizer and pesticides).

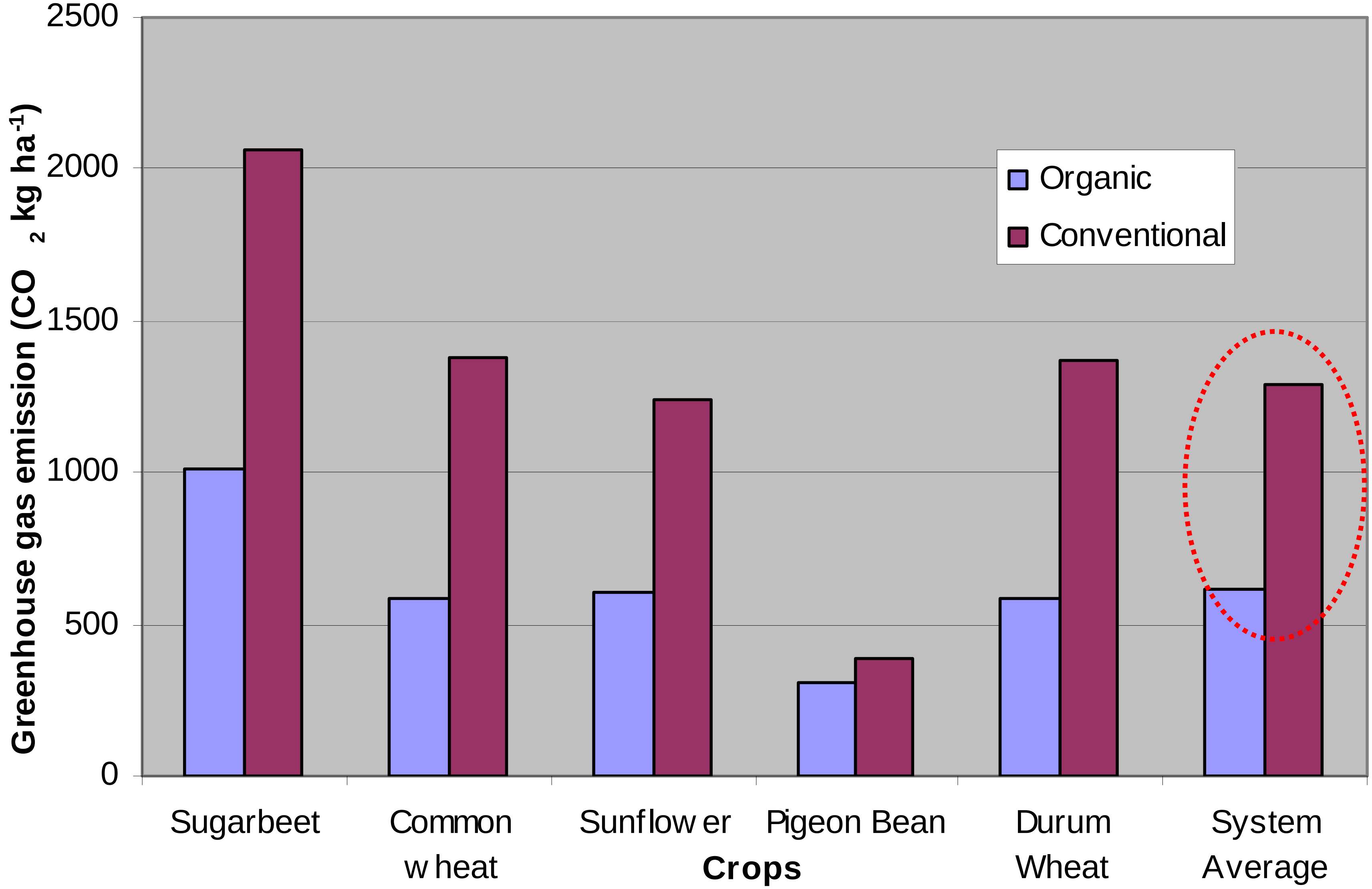
Emission…………

Total GHGs emission (CO_2 equivalent kg/ha)



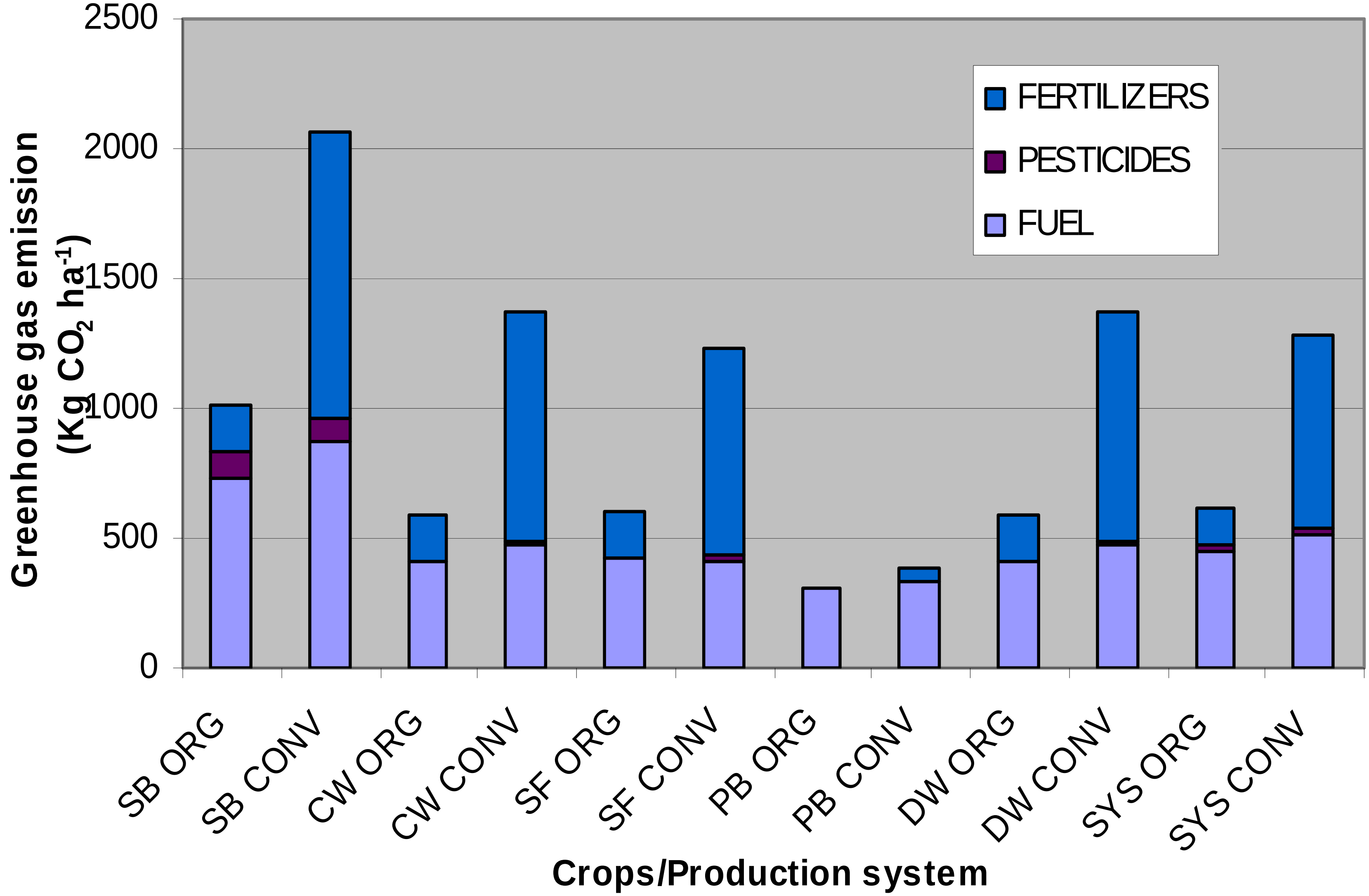
Emission…………

GHGs emission from two production systems



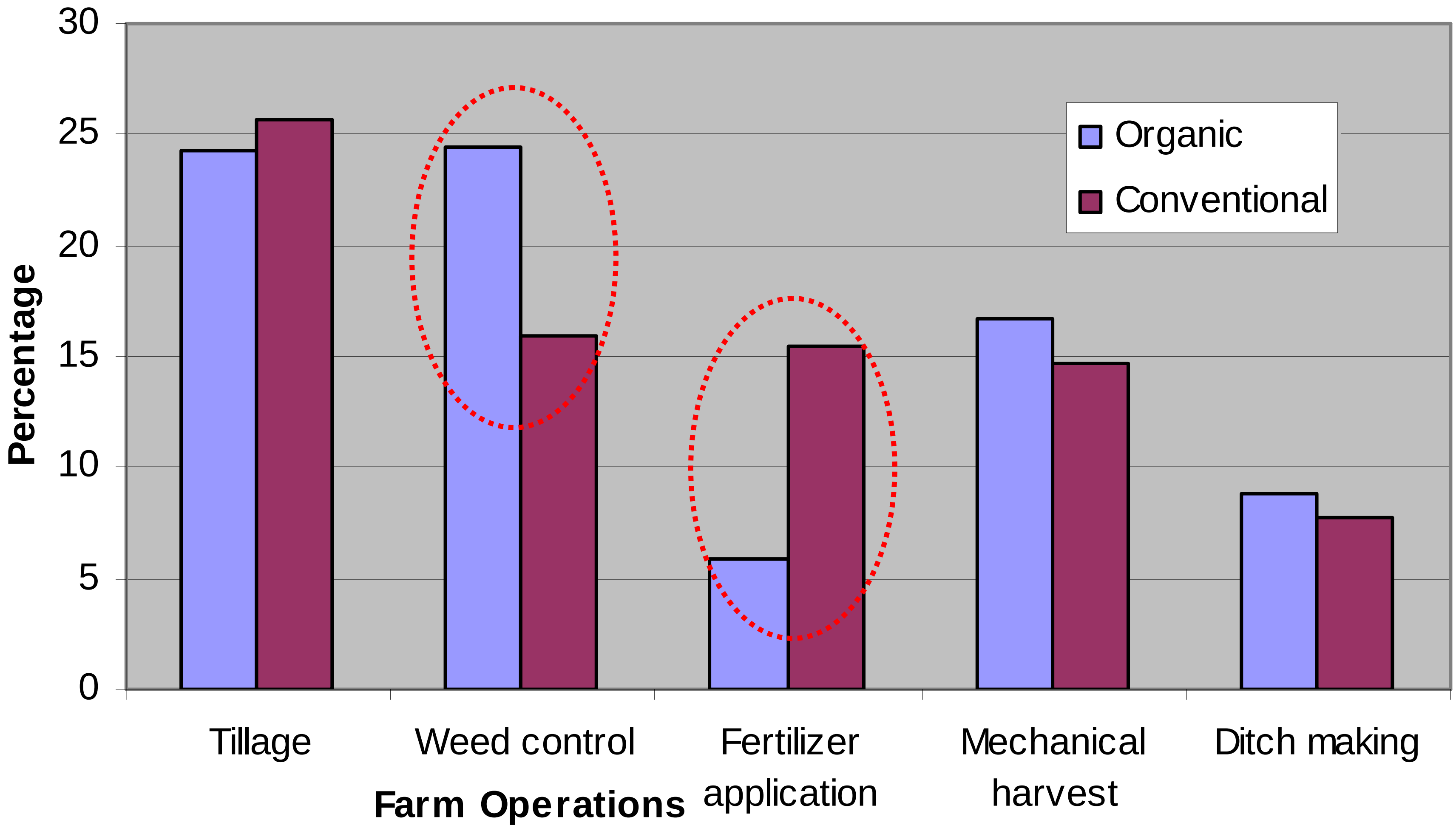
Emission…………

GHGs emission from two production systems as influenced by different agricultural activities



Emission…………

Contribution of different farm operations to total fuel consumption-based emission



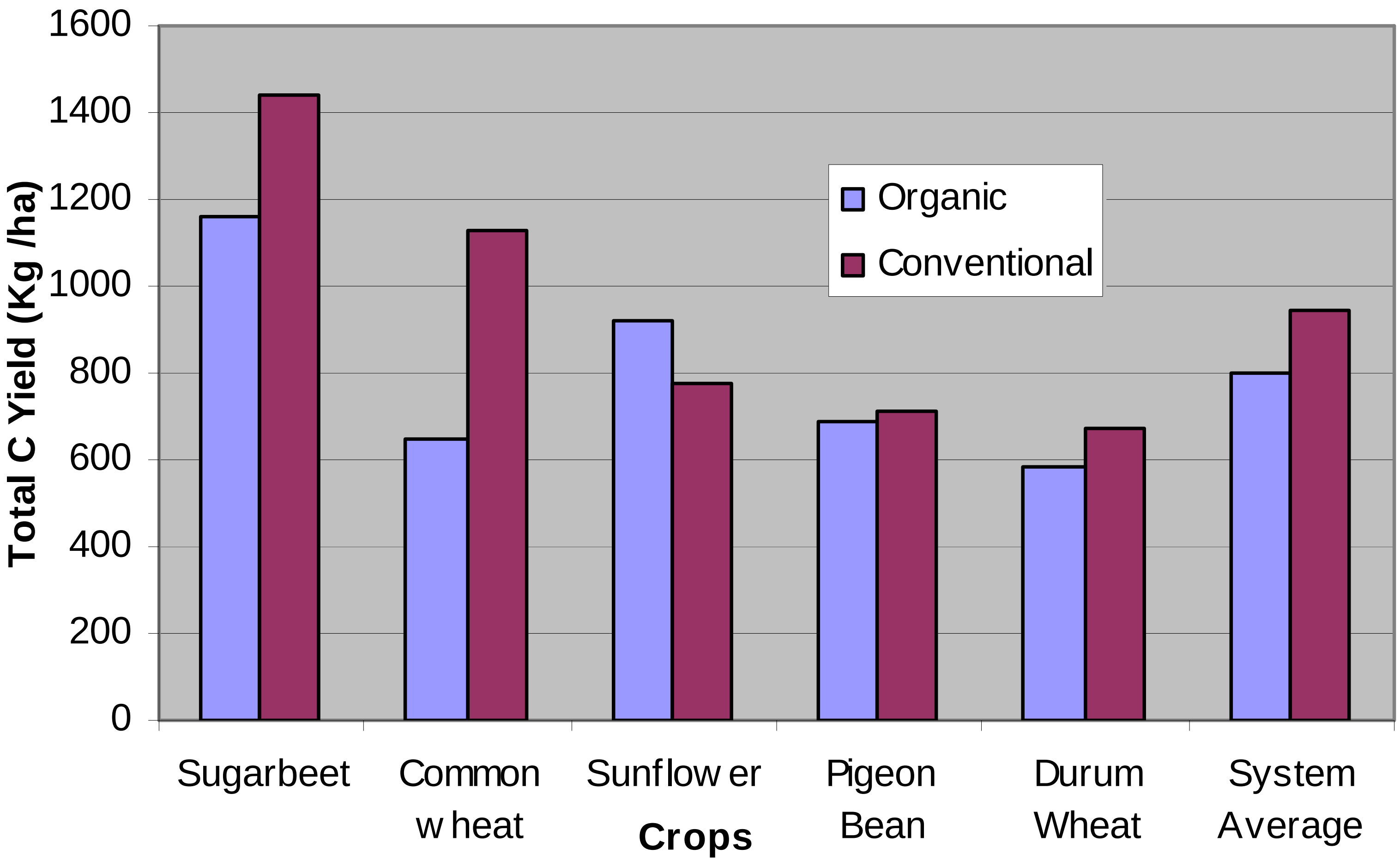
Carbon yield

Total Carbonic yield from two production systems

Grain and residue yield

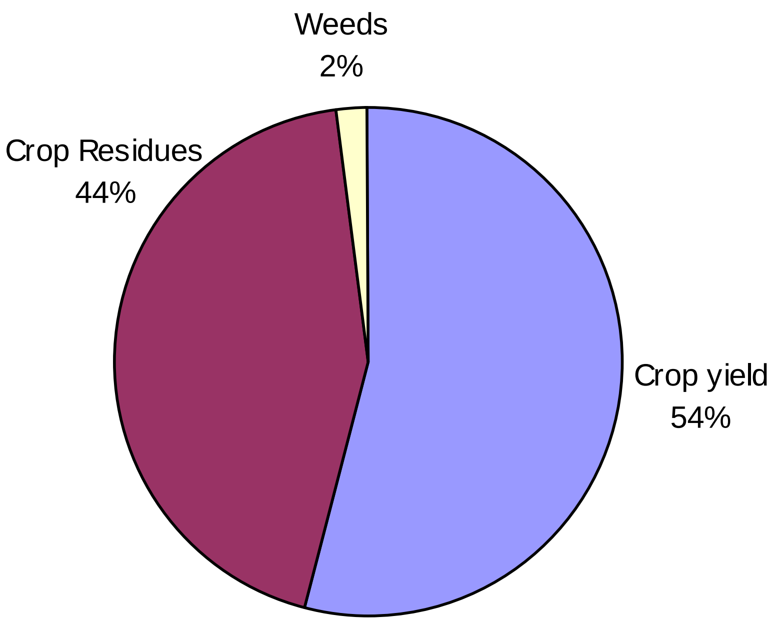
Green manure yield

Weed biomass

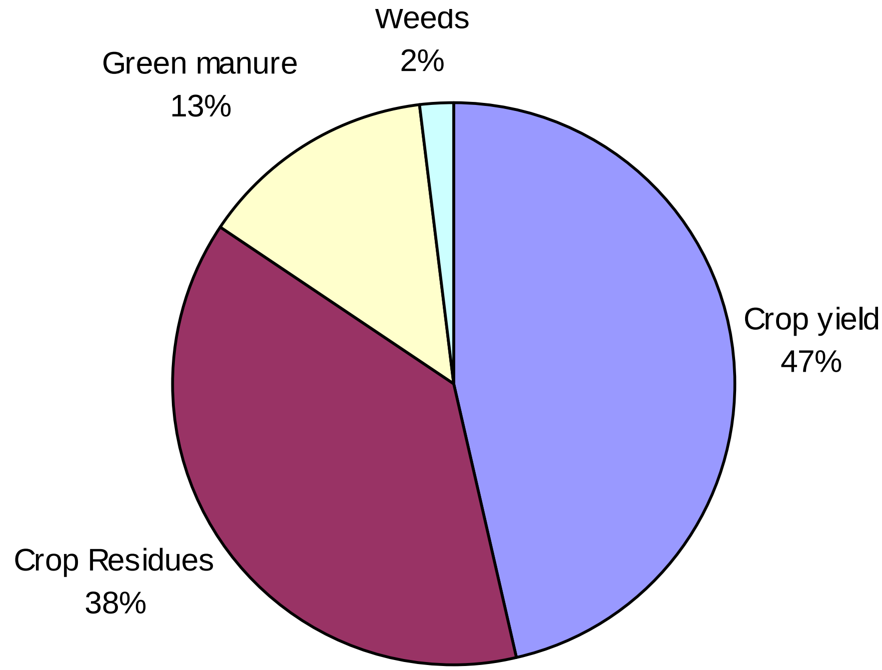


Carbon balance…………

Contribution of different components in total Carbon Yield from two systems

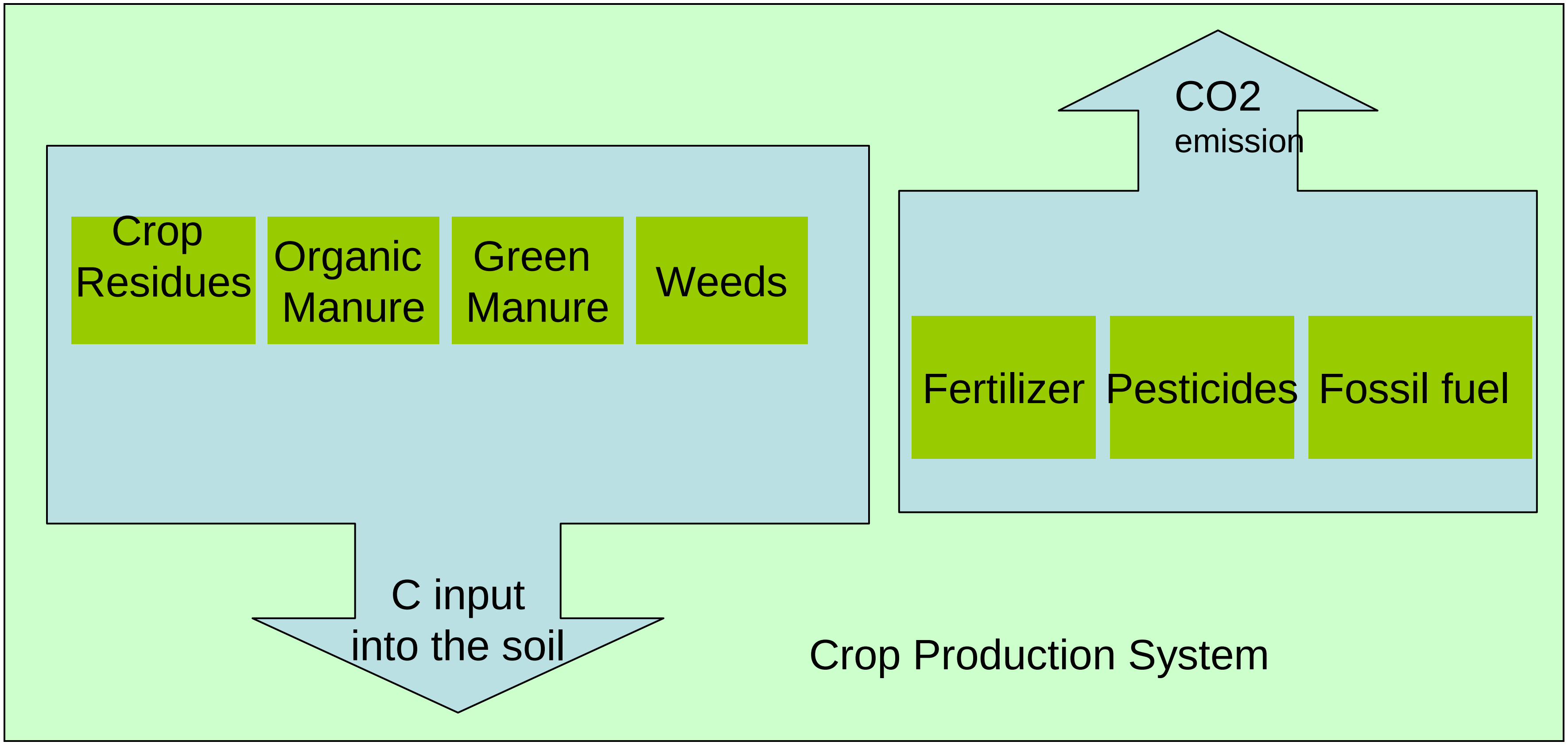


Conventional



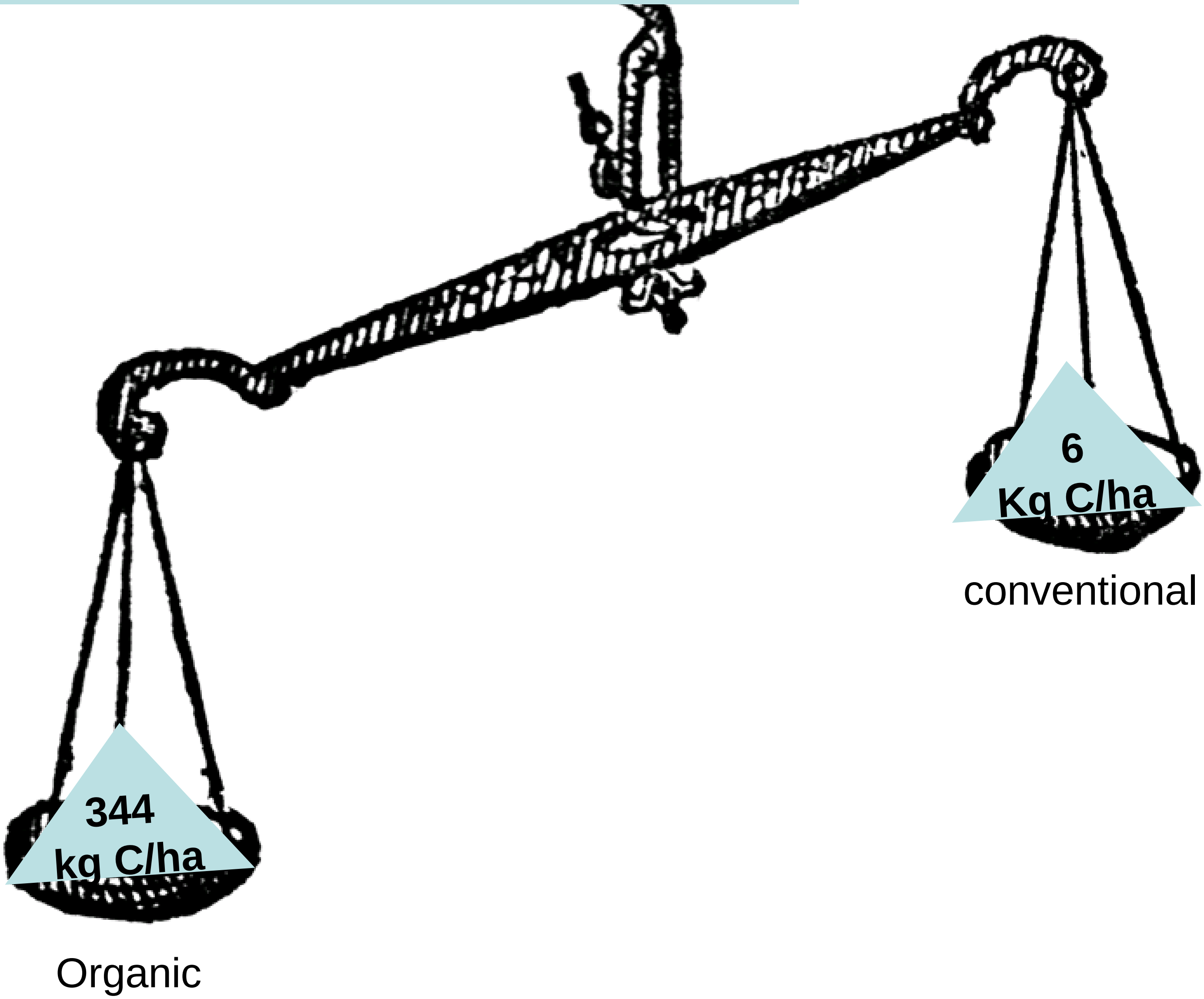
Organic

Carbon balance



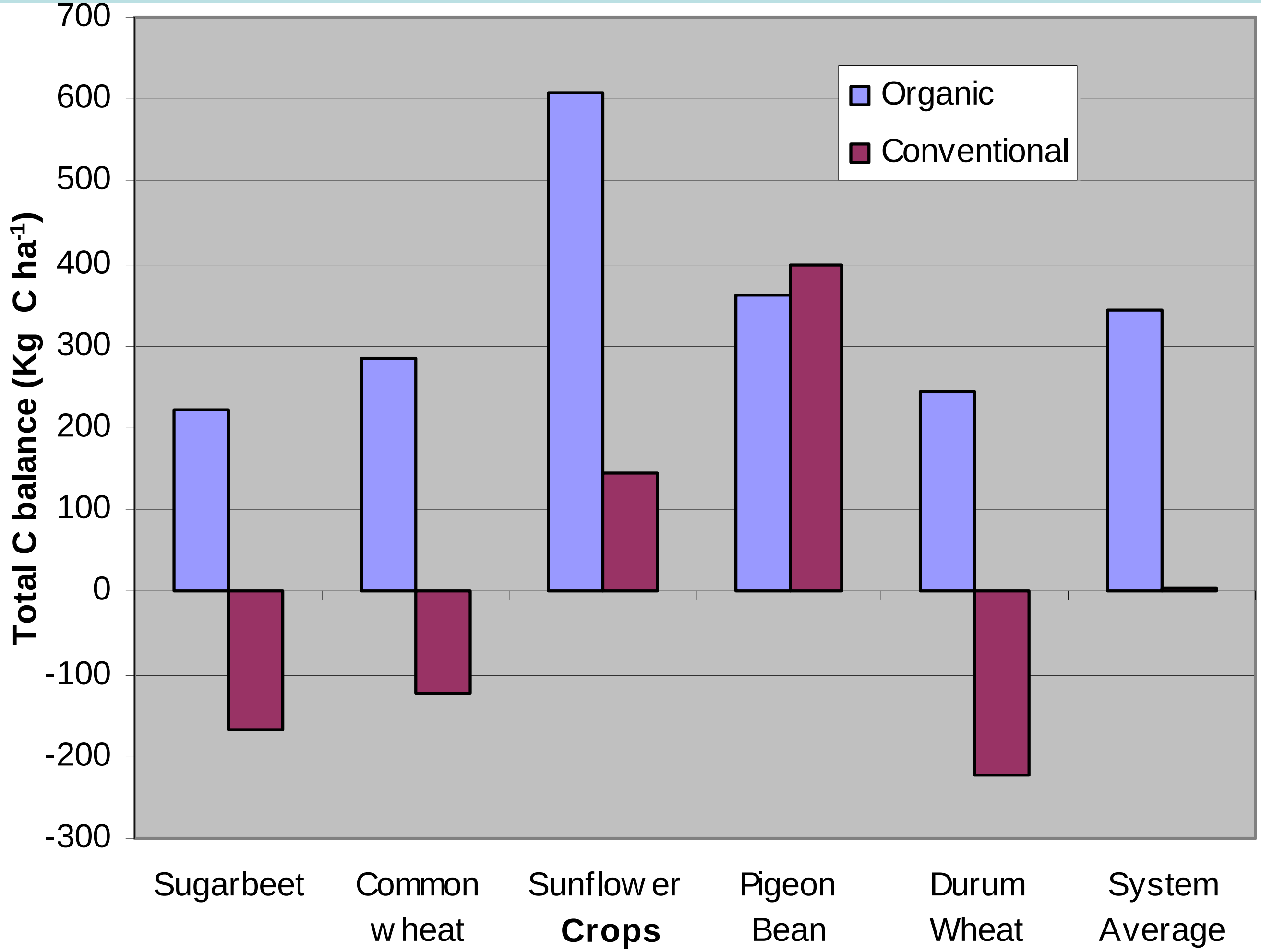
Carbon balance…………

Total Carbon sequestration (C q/ha)



Carbon Balance…………

Total Carbon Balance in soil from two cropping systems



- Positive value indicates sequestration of atmospheric carbon to soil
- Negative value indicates loss of C from soil and subsequent release in atmosphere

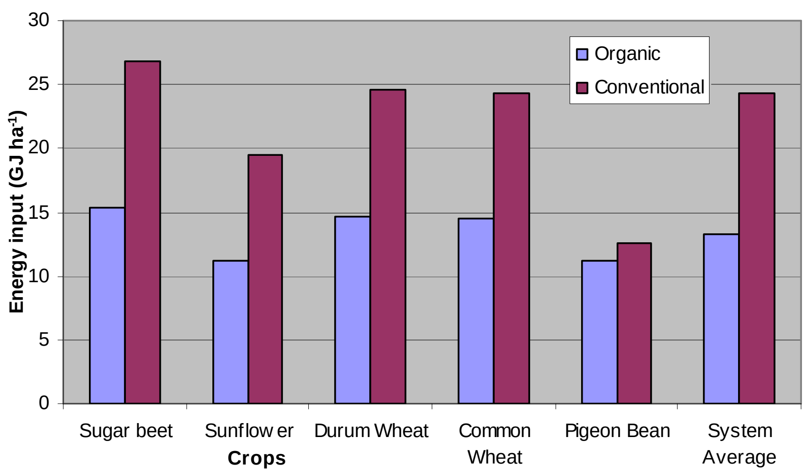
Energy Balance

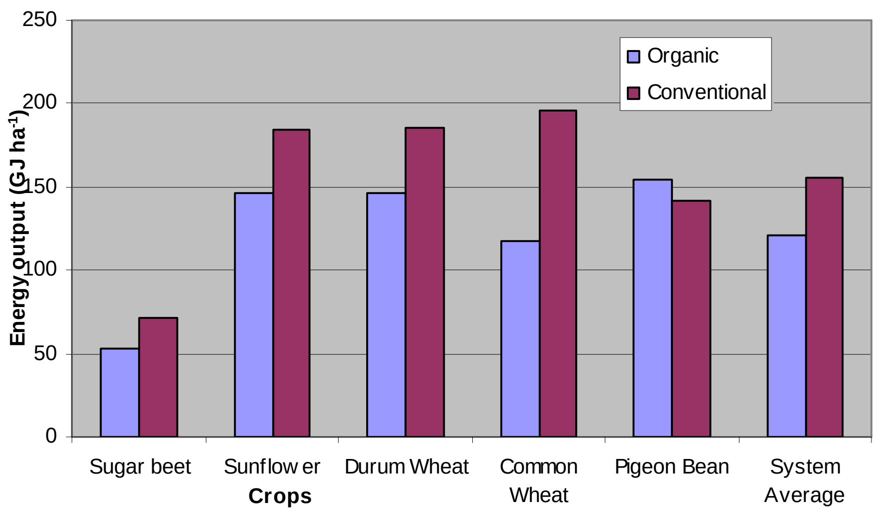
Energetic index developed by Bonari et al, (1992)

Input	EI(MJ kg-1)	Output	EI (MJ kg-1)
Oils		**Yields**	
Gasoil	44.4	Wheat	13.4
Oil	80	Sugar beet	2.90
Fertilizers		Sunflower	21.8
N	75.3	Pigeon bean	16.7
P	12.6		
K	9.6		
Pesticides		**By-products**	
Herbicides	91.3	Wheat	17.6
Insecticides	52.7	Sugar beet	11.7
Fungicides	55.7	Sunflower	15.9
Seeds		Pigeon bean	15.9
Wheat	17.2		
Sugarbeet	54		
Sunflower	25.5		
Pigeon bean	33.5		
Machine			
MJ/hr	Wt of machine (kg) X energetic index (Mj/Kg) /life of machine (hrs)		
MJ/ha	Hr/ha X MJ/hr		

Energy Balance

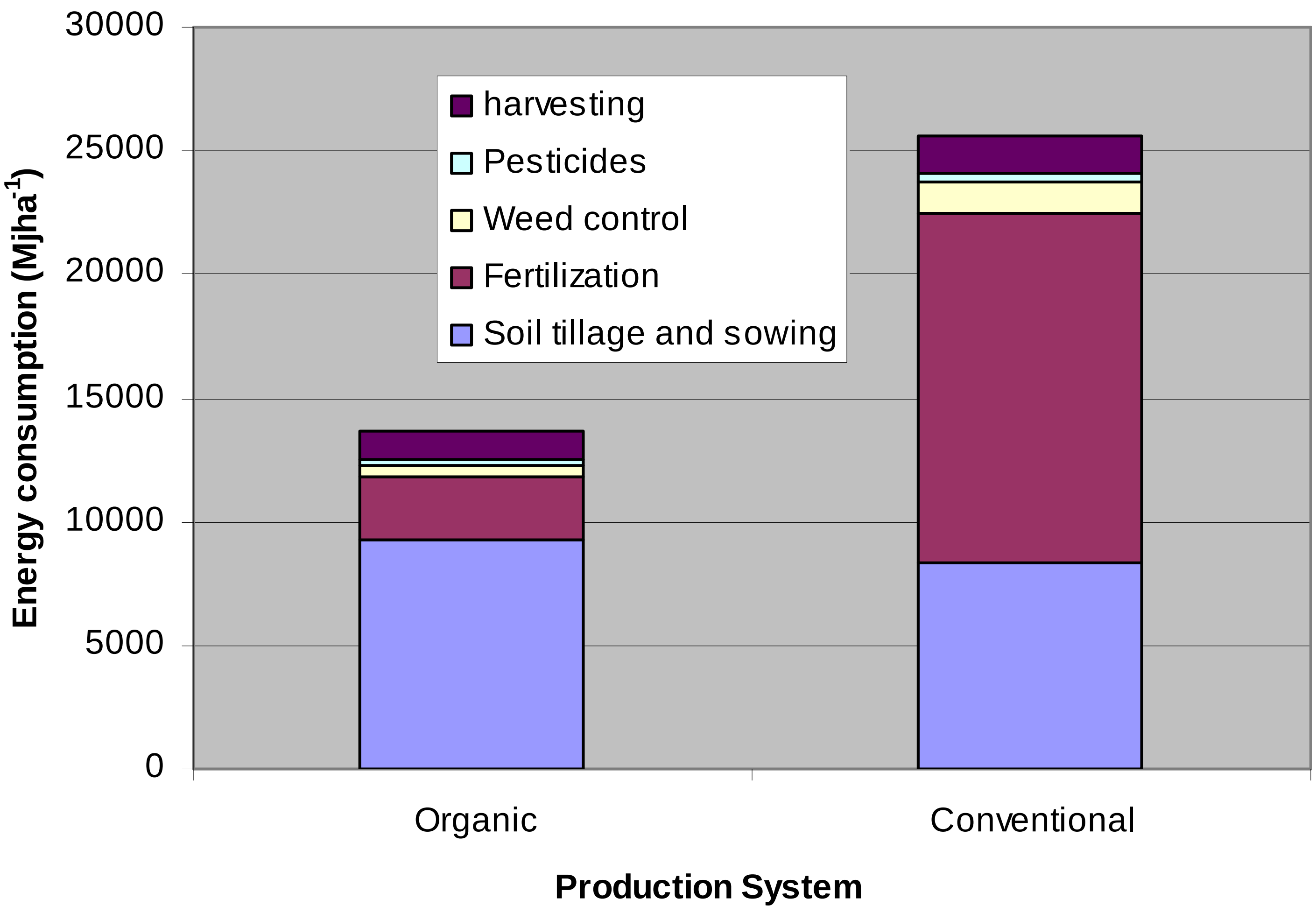
Energy input and output in two cropping systems





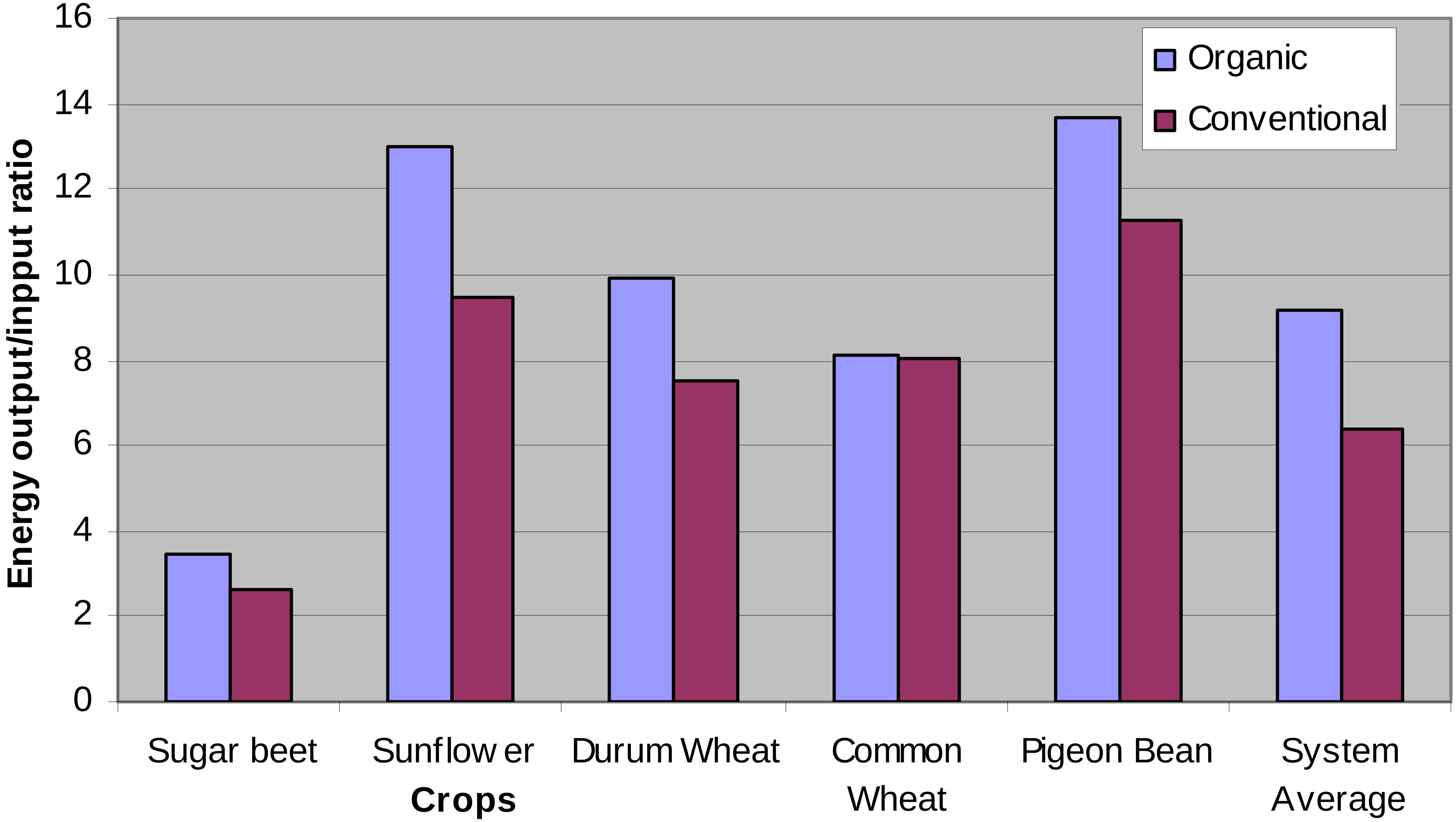
Energy balance…………

Energy consumed by various agricultural operations in two production systems



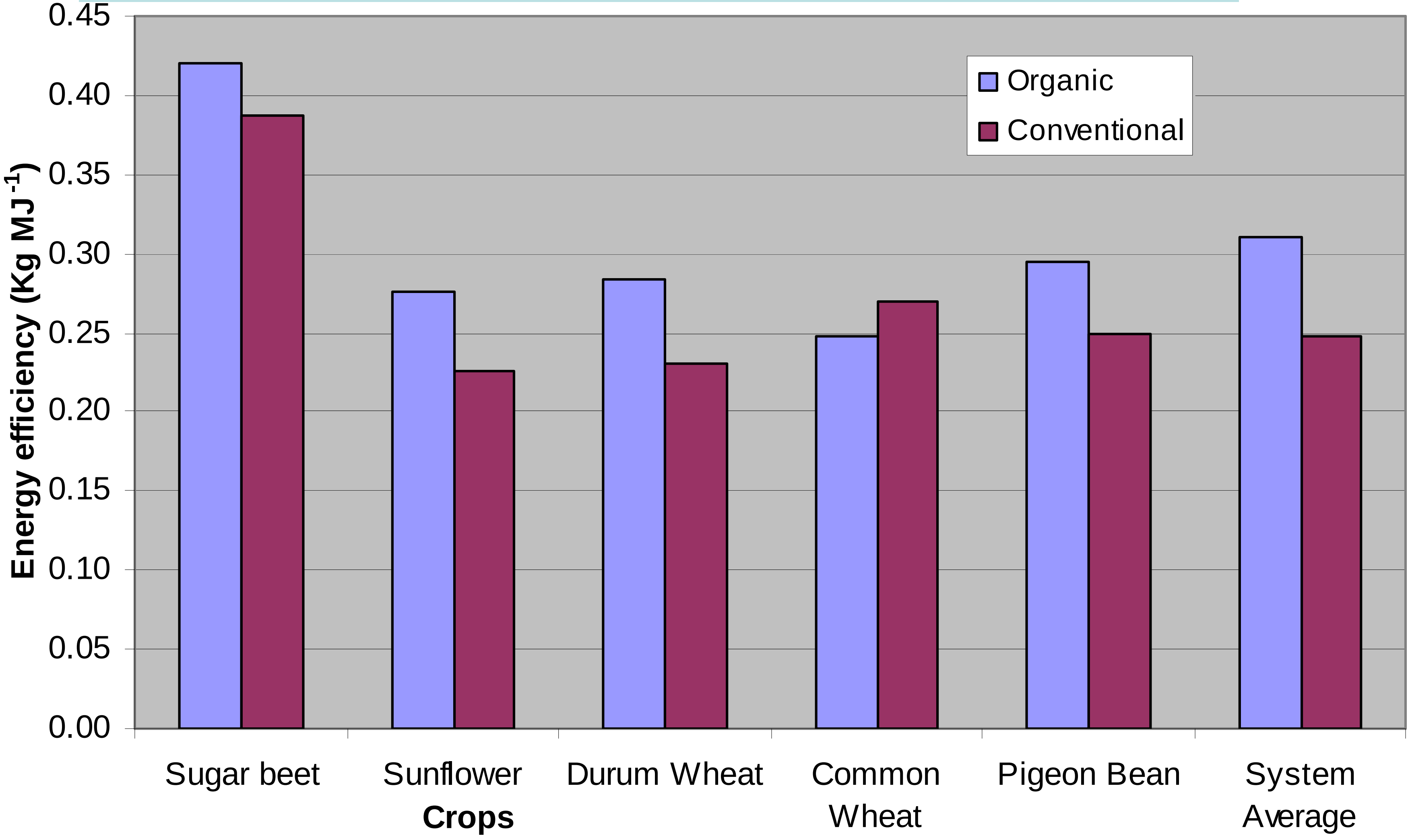
Energy balance…………

Energetic Output Input Ratio



Energy balance…………

Efficiency of energy use in two production system (Economic yield/energy input)



Conclusion

Organic production of arable crops under Mediterranean condition significantly contribute to mitigate climate change as compared with its conventional counterpart by:

-emitting less CO_2 into the atmosphere
-sequestering more C into the soil from atmosphere
-by consuming less energy per unit area of farming


Thank you for you attention