Carbon and water footprint assessment of the Mauritian sugar cane sector

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Accountable by Nature

FAIRTRADE INTERNATIONAL

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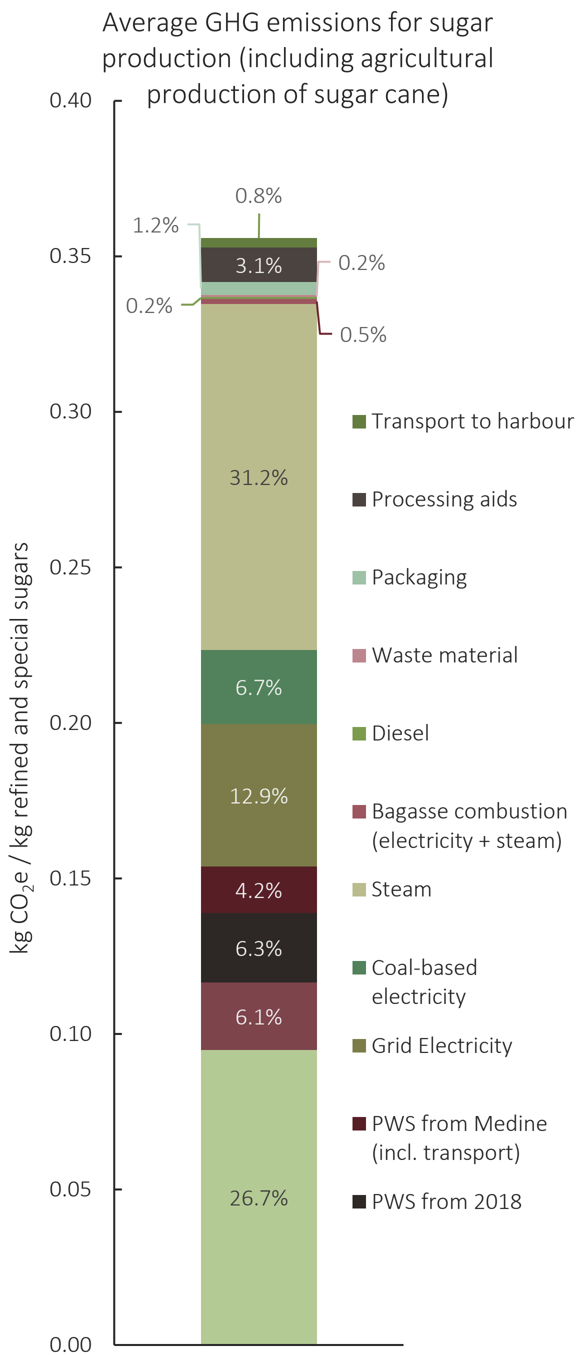
Goals and scope of the assessment

- Assess the Carbon and Water footprint of cane sugar from Mauritius of agriculture, processing and transport to harbor based on 2019 data
- Show biggest emission sources and sinks and give recommendations for improvement
- Unit of analysis: 1 kg of white/special sugars in Port Louis

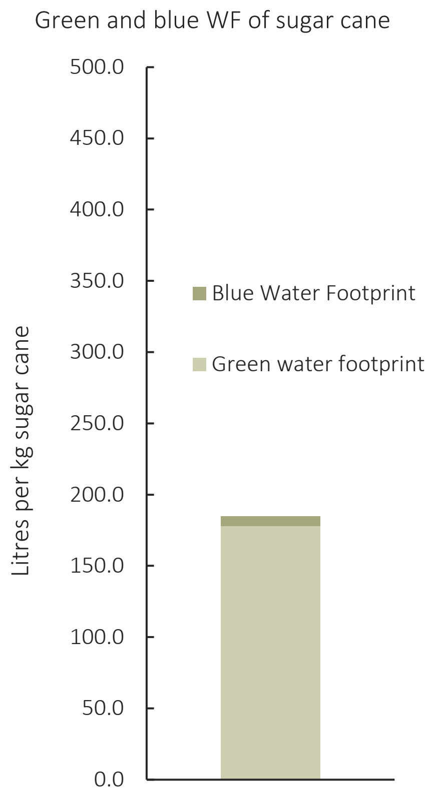
Scope	Agriculture	Processing	Transport
Units assessed	3 clusters with tot 38 farms	2 mills	Estimations From clusters and mills
Type of assessment	Carbon and water footprint	Carbon and water footprint	Carbon Footprint
Assessment method	Data collection app operated by local FT officers	Email questionnaire	Via Email
Recommendations	Farming level	-	-

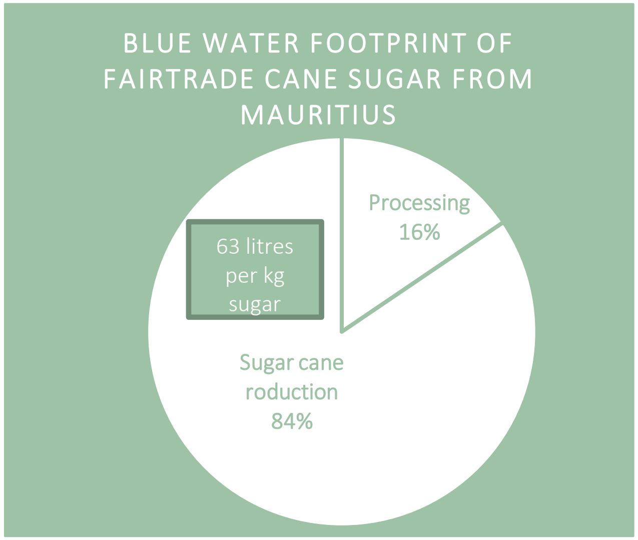


Summary- Carbon Footprint

- Cane sugar PCF amounts to 0.36 kg CO_2e /kg at harbor
- **26.7%** of total emissions can be attributed to sugar cane cultivation, **6.1%** to transport from farms to refineries, **55.9%** to processing, and **0.8%** to transport from refineries to harbor, **10.5%** are embodied GHG emissions of plantation white sugar from 2018/Medine refinery
- Processing contributes the largest share of emissions, mainly due to the substantial quantity of steam, partly derived from coal, and grid electricity consumed

Summary-Water Footprint





- Agricultural production:
  - Green WF: 178 l/kg
  - Blue WF: 6.8 l/kg
  - Grey WF: 1,818 l/kg; most critical agent: DMA6, 2,4-D Sel Amine
- 84% of blue WF due to agricultural production, whereas processing accounts for 16 %
- Combined, these two stages generate a blue water footprint of 63 liters per kg sugar (when corrected for wastewater use for irrigation)
- 67 liters per kg sugar when not taking irrigation of sugar cane with wastewater into account

Farm Clusters

- Productivity ranges from 40 to 100 tons/ha
- Farms in cluster 2 are smallest, with average 0,8 hectares whereas the yields are largest with average 92,8 t/ha.

Below table shows the main characteristics of the 3 clusters.

Cluster	Geo-Climate	Average crop area/farm	Average Yield t/ha	Dominating soil type	Soil drainage	SOM	Soil humidity	Irrigation
1	Center: rainy and hilly	1.34	57.35	clay	poor	low	moist	0 of 16
2	North: low rain and flat	0.76	92.76	mixed	good	mixed	moist	9 of 11
3	South: low rain and hilly	1.23	69.95	silt	good	mixed	dry	3 of 11
Grand Total		1.14	71.25					

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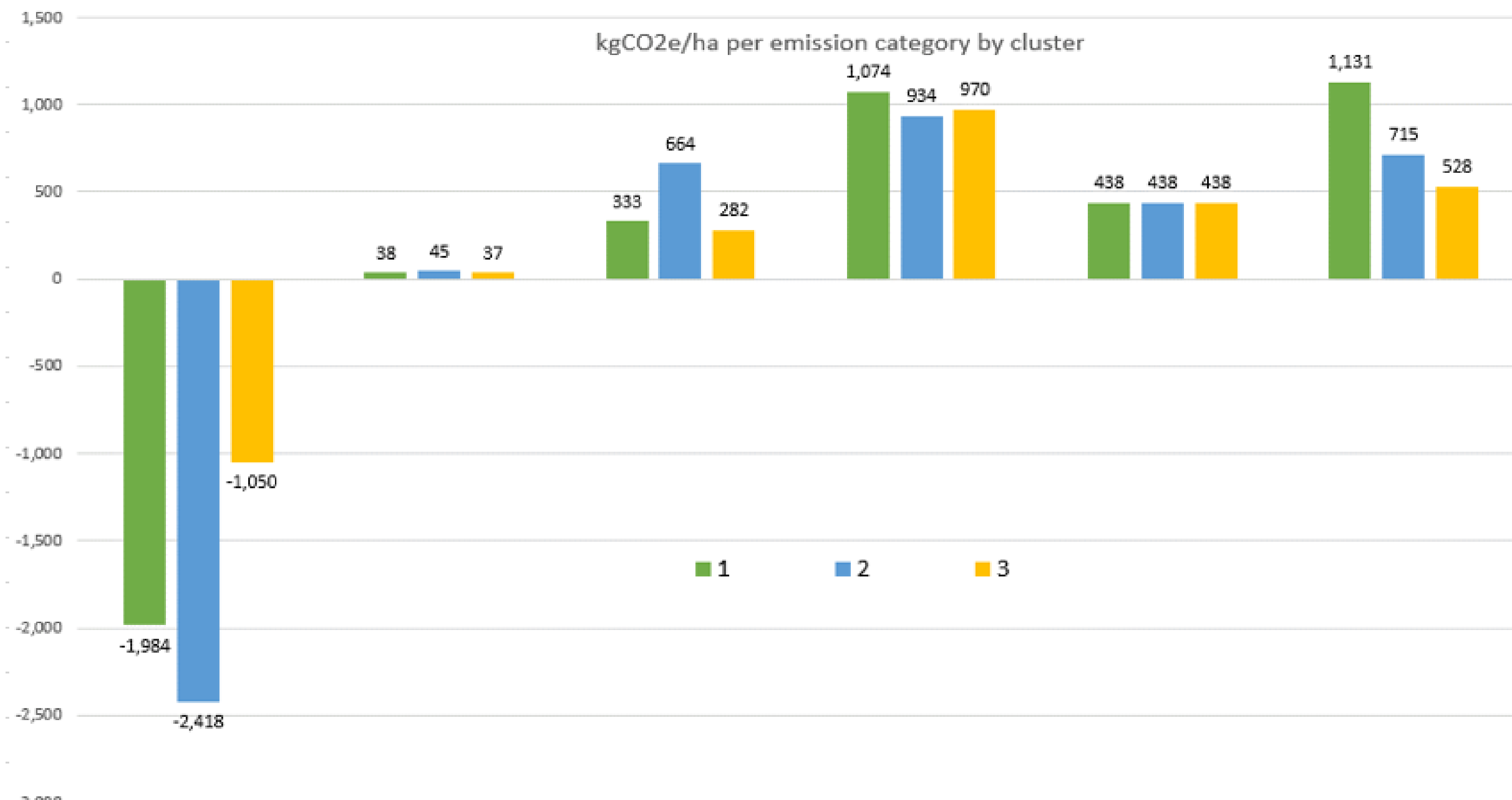
Results per farm cluster



	Carbon stock changes	Crop protection	Energy use	Fertiliser production*	Residue management	Soil / fertiliser
1	-1,984	38	333	1,074	438	1,131
2	-2,418	45	664	934	438	715
3	-1,050	37	282	970	438	528

Results per cluster - details

- **Carbon stock changes:** All 3 clusters store carbon in the soil. Changing from conventional to reduced tillage improves carbon sequestration. In Cluster 2, most land has undergone a conversion from conventional to reduced tillage followed by Cluster 1. In Cluster 3, some farmers have gone from red. to conv till. Therefore, less carbon sequestration took place in C 3. SOM also plays a role in C sequestration – the more SOM in the soil, the faster biomass can be incorporated.
- Overall, Cluster 2 performs best on productivity and footprinting level due to good soil quality, high inputs (mechanization, irrigation and fertilizers), reduced tillage, combined with a well-drained soil with reasonable SOM which is able to sequester more carbon.

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Water footprint (WF) per cluster

- Cane cultivation zones vary from dry to superhumid, and 12 of 38 farms have irrigation, most of them in Cluster 2.

Cluster	Erosion risk*	Green WF/natural water use	Blue WF/ irrigation	Grey WF/ pot. water contamination	Measures
C1	high	1076,4 mm	0	1,818 l/kg sugar cane	Increase productivity/soil structure
C2	low	1004,4	221,1		Use effective irrigation (rain gun?)
C3	medium	1273,5	123,5		

* Estimated from available data

In C1, blue WF is 0 as farms are not irrigated. The green WF can be reduced by increasing productivity. When soil structure is improved, available water can be used more efficiently also in the dryer season. Erosion potential is high due to the hilly terrain and high amount of rainfalls.

The grey water footprint can be reduced by reducing use of the most critical agent with the highest value for the agr. grey water footprint:DMA6, 2,4-D Sel Amine.

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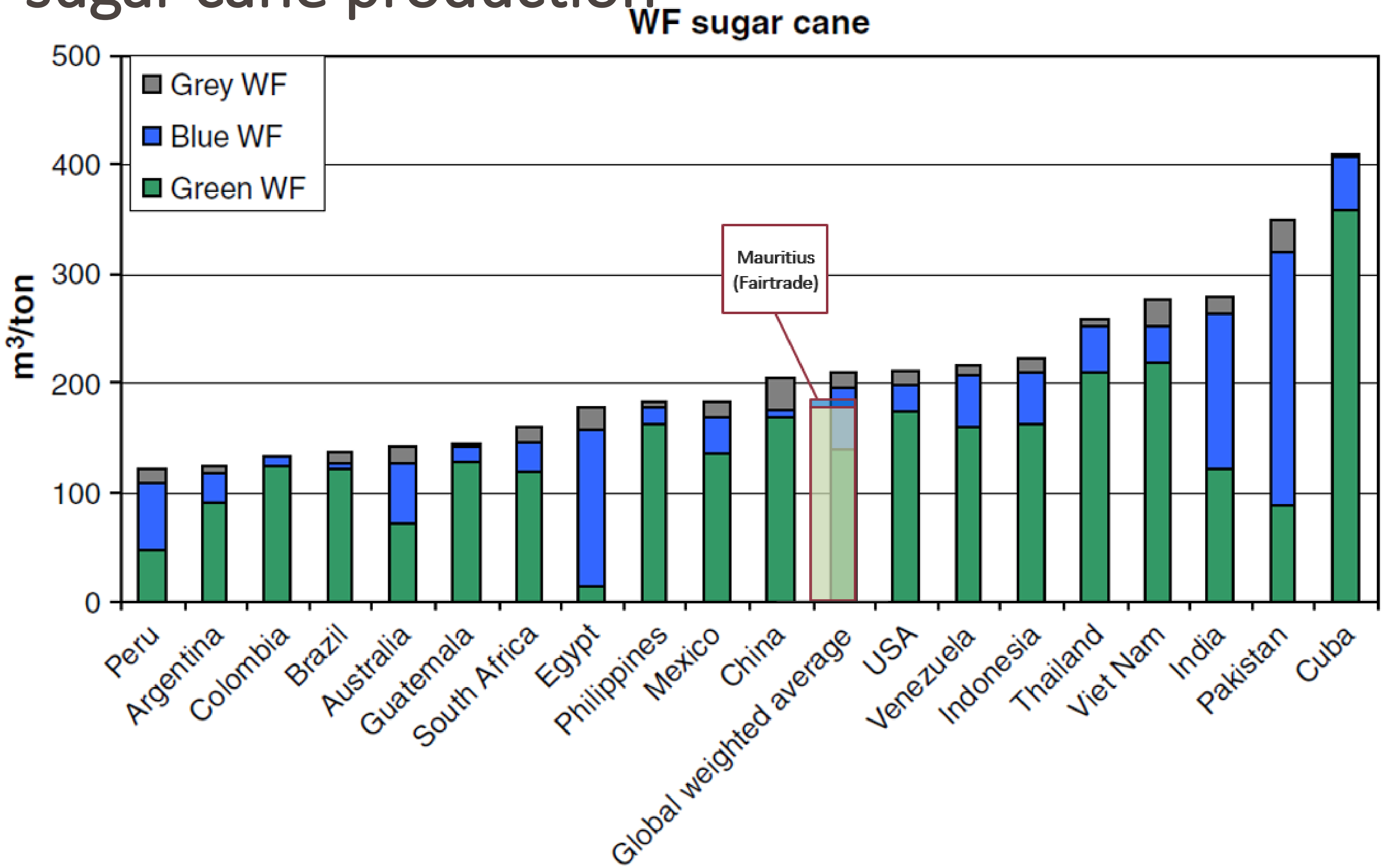
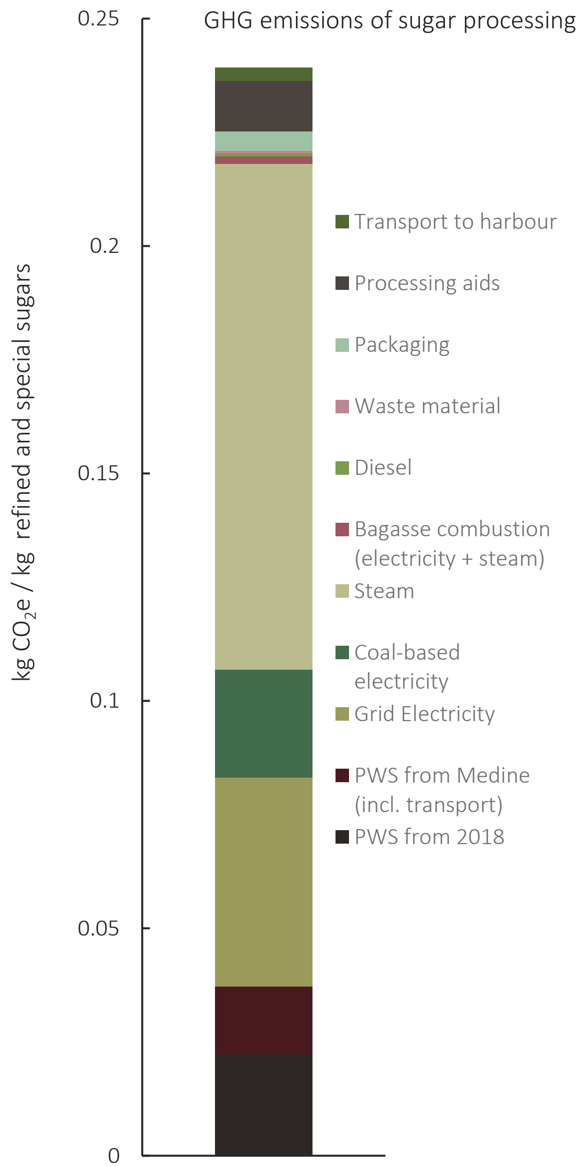
Global comparison of green and blue WF of sugar cane production



Carbon and water footprint of sugar processing



- Steam is the largest source of GHG emissions
- grid and coal-based electricity together form 2nd largest portion
- Use of bagasse-based electricity and steam contributes to lower overall emissions
- Processing aid is next largest source
- Blue WF of processing: 10 liters per kg refined and special sugars

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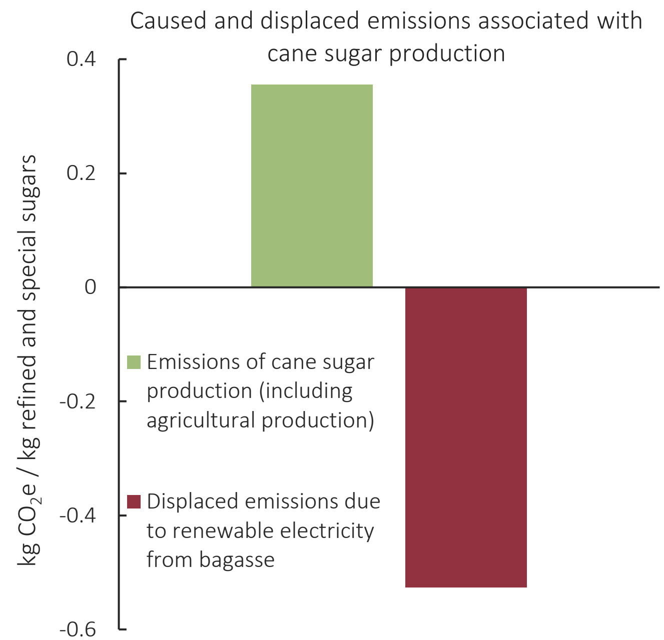
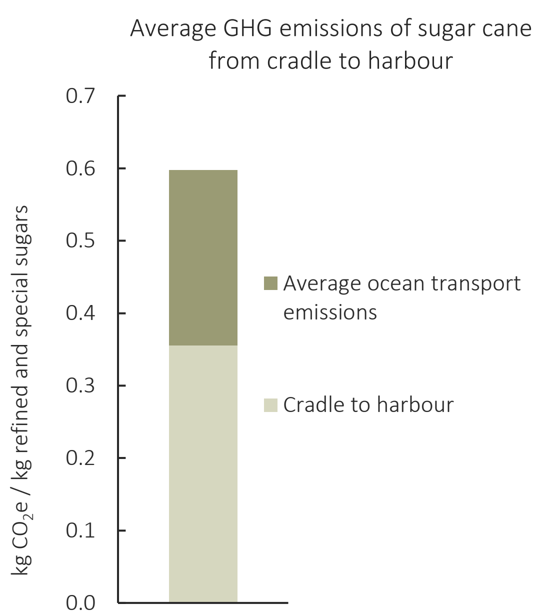
System expansion

- Displaced emissions associated with grid electricity due to bagasse-based electricity outweighs emissions from agricultural production over processing to transport to Port Louis by 0.17 kg per kg sugar



Ocean shipping



- Ocean transport to Europe would contribute another 0.24 kg per kg sugar
- Taking ocean shipping into account, displacement of grid electricity no longer outweighs entire emissions

Reducing the impacts

- Agriculture: Soil-build up and erosion prevention constitute the greatest opportunities for improving the overall product impact while generating valuable co-benefits.
- Processing: Additional efforts are under way to move towards a circular production process, which should further reduce emissions.
- Biggest (positive) impact on blue water footprint on agr. level is to limit the amount of irrigation water by keeping the soil covered, and water recycling in processing.
- The grey water footprint could be reduced by reducing the use of the most critical agent with the highest value for the agr. grey water footprint:DMA6, 2,4-D Sel Amine.

Recommendations on farming level

- Continuing efforts to promote green cane harvesting (as has been historically practiced in Mauritius)
- Reducing tillage
- Keeping soil always covered
- Introducing organic fertilization by returning residues from sugar mills to the soil
- Erosion prevention
- Keeping soil surface possibly rooted
- Raise the pH to approx. 6,5
- Pay attention to salinity
- Check and change fertilizers origins

Details on each practice can be found in the report: Carbon and water footprint assessment for cane sugar from Mauritius

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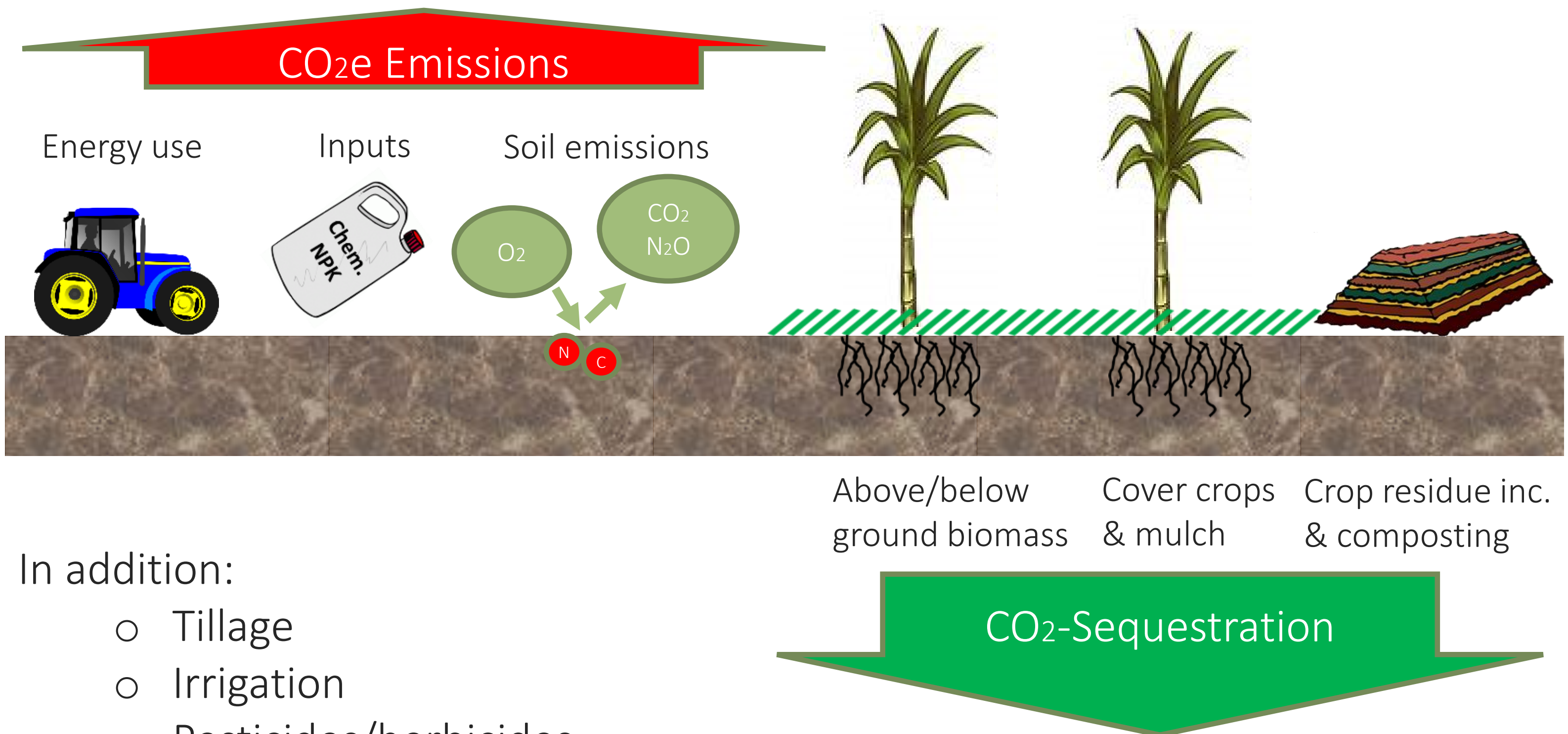
Practices considered at farming level



In addition:

- Tillage
- Irrigation
- Pesticides/herbicides
- Transport to next stage : the transport of sugar cane from farms or collection points to the sugar refineries could not be considered due to errors in the GPS coordinates entered. However, this is unlikely to make a substantial difference.

Practices considered at processing level

- Electricity
- Diesel
- Transport
- Waste material
- Water used
- Waste water
- Packaging
- Sugar Cane

Methodology

- GHG Protocol (www.ghgprotocol.org/product-standard)
- Calculation models and tools based on Cool Farm Tool (https://coolfarmtool.org/) for farming level
- Defra emission factors (www.gov.uk/government/collections/government-conversion-factors-for-company-reporting) and International Energy Agency (IEA) emission factors (https://webstore.iea.org/emissions-factors) to model processing and transport emissions
- Water footprint: the model CropWhat 8.0 and ClimWhat 2.0 database was used (https://waterfootprint.org/media/downloads/TheWaterFootprintAssessmentManual_2.pdf)

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