Irrigated sugarcane: an environmentally friendly C-sequestration C4-crop

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Commercial sugarcane is a semi-perennial C4 crop growing yearly 11 out of the 12 months and is harvested every year. Stalk yields above 100 t/ha/year are obtained with best farming practices in warm and irrigated areas with high net radiation as is the semiarid zone. In such part of Sudan, the C-level of grumulosic vertisols under irrigated sugarcane for the past 15 years was compared to the one existing in traditional dry land farming. The analysis concerns also the dry matter production of the cane crop while it furnishes the energy needed by the mill and for the irrigation.
In the studied area, the cane is burned immediately before the harvest and, due to the presence of termites, all crop residues are burned before regrowth of the ratoon cane or cane planting.

Ratoon cane under furrow irrigation with siphons.

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Material and Methods

The results are based on:
- measurements of the organic C content and of the bulk density (at litre level, on field capacity) of the soils at four levels between 0 and 105 cm depth,
- general data concerning above-ground green matter production of cane at harvest and its dry matter content, as well as data on root growth.

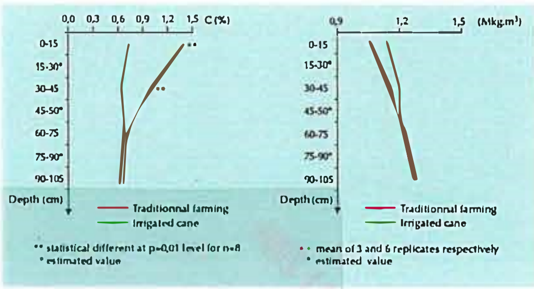
Results

In the first metre of the soil, irrigated sugarcane cropping boosted the C content by almost 30% (115 vs. 84 t/ha) and by 82, 50, 7 and 9% for the depths 0-15, 30-45, 60-75 and 90-105 cm respectively. Due to the burning of the cane before harvest and of the crop residues after harvest, the increase in C is essentially due to the yearly root growth of the cane. The increase in soil organic matter represents about 16% of the total dry matter of the harvested cane stalks since the start of sugarcane growing (mean yield of 70 t/ha/year) and 9,5% of the total above ground dry matter production for the same time-span.

Table 1. Carbon (t/ha).

Depth (cm)	Irrigated cane	Traditional farming	Increase in C (%)
0-15	23.1	12.7	**81.9**
15-30	20.3	12.1	**67.8**
30-45	15.0	11.9	**26.1**
60-75	13.2	12.3	**7.3**
75-90	13.0	12.0	**8.3**
90-105	12.9	11.8	**9.1**
0-105	**114.8**	**84.3**	**30.1**

Figure 1. Organic carbon (%) and bulk density.



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Cane burning before harvest.

Considering the energetic aspect of the cane crop, at the 70 t C/ha yield level, the burning in the mill of the bagasse by-product during the crushing season covers largely the energy need of the mill as well as those used by the neighbouring township and needed for the cane fields irrigation.
However, considering that:
(i) a mean yield level of 100 t cane stalks per ha and that 1 ton of cane stalks produce 260 kg of bagasse (mainly fibres with some sugars and 50% water),
(ii) a significant improvement of the conversion in energy of the bagasse is realised (the current conversion efficiency is 15 to 20% but this may reach 30 to 35% with high pressure technology),
it will be possible by sugarcane growing to supply not only the energy needs for year round irrigation, but also those that compensate the energy that is necessary for the manufacturing of the fertilisers that the crop needs or the one equivalent to the motorised farm and harvesting operations.

Motorised loading of hand cut whole cane stalks.

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Conclusion

In semiarid areas, well-managed sugarcane is a crop that presents the advantage to bring over a 15 year period the SOM content of the soil to a much higher level (here + 30%, i.e. + 30 t C/ha or 2 t C/ha/year) than is observed under traditional rainfed farming. On the other hand, by burning the bagasse, this crop may produce more energy than needed for its production and for the processing of the harvested cane stalks. At the same time, cane growing may produce more then 10 tons sugar + several tons of molasses per ha.

The sugar mill with its chimneys and bagasse hill.

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