Carbon footprint of typical agriculture production systems in Florida

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Introduction

Agriculture activities are an important source of greenhouse gases (GHG) in many countries. In 2008, agriculture accounted for nearly 6% of total U.S.GHG emissions. The use of forest plantations and management practices can contribute to decrease or offset GHG emissions from agriculture, while forestry is also a good alternative to diversify production systems.

Objectives

The main objective of this study was to estimate the GHG emissions from a hypothetical farm in Florida, USA. We wanted to quantify GHG emissions from agricultural activities in the farm and estimate the area of forest required to offset them. Typical crops, livestock, forest systems and management practices used in the region were considered in the study.

Materials and Methods

System boundaries and GHG sources are described in Figure 1. Only forest was considered as carbon sink.

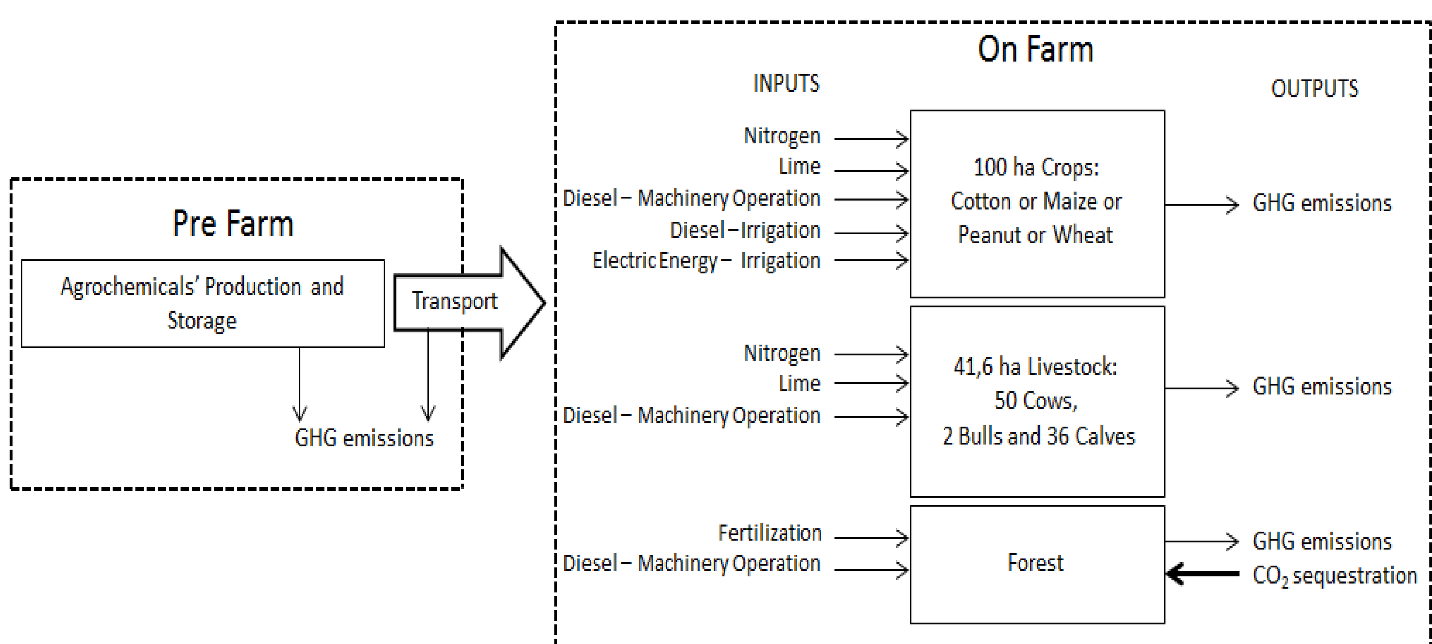


Figure 1. System boundaries and GHG sources.

Areas of cropland in the farm were assumed to be 100 ha in size and could have different management systems. For cotton, maize and peanut, the management systems were: conventional tillage/non-irrigated, strip-till//non-irrigated, conventional tillage/ irrigated, and strip-till/irrigated. For wheat two management systems were adopted: conventional and intensive. For livestock, a typical cow-calf operation was simulated with an average size for Florida production systems (Kunkle et al., 2012) on pasture, with low inputs (Figure 2).

Pre Farm GHG emissions are related to the production, transportation and storage of agrochemicals, calculated using emission factors described by Lal (2004a). On Farm GHG emissions were based on the methodologies described in the Guidelines for National Greenhouse Gas Inventories (IPCC, 2006), with specific emission factors for the USA or Florida when available from the Environmental Protection Agency (EPA) and Environmental Investigation Agency (EIA).

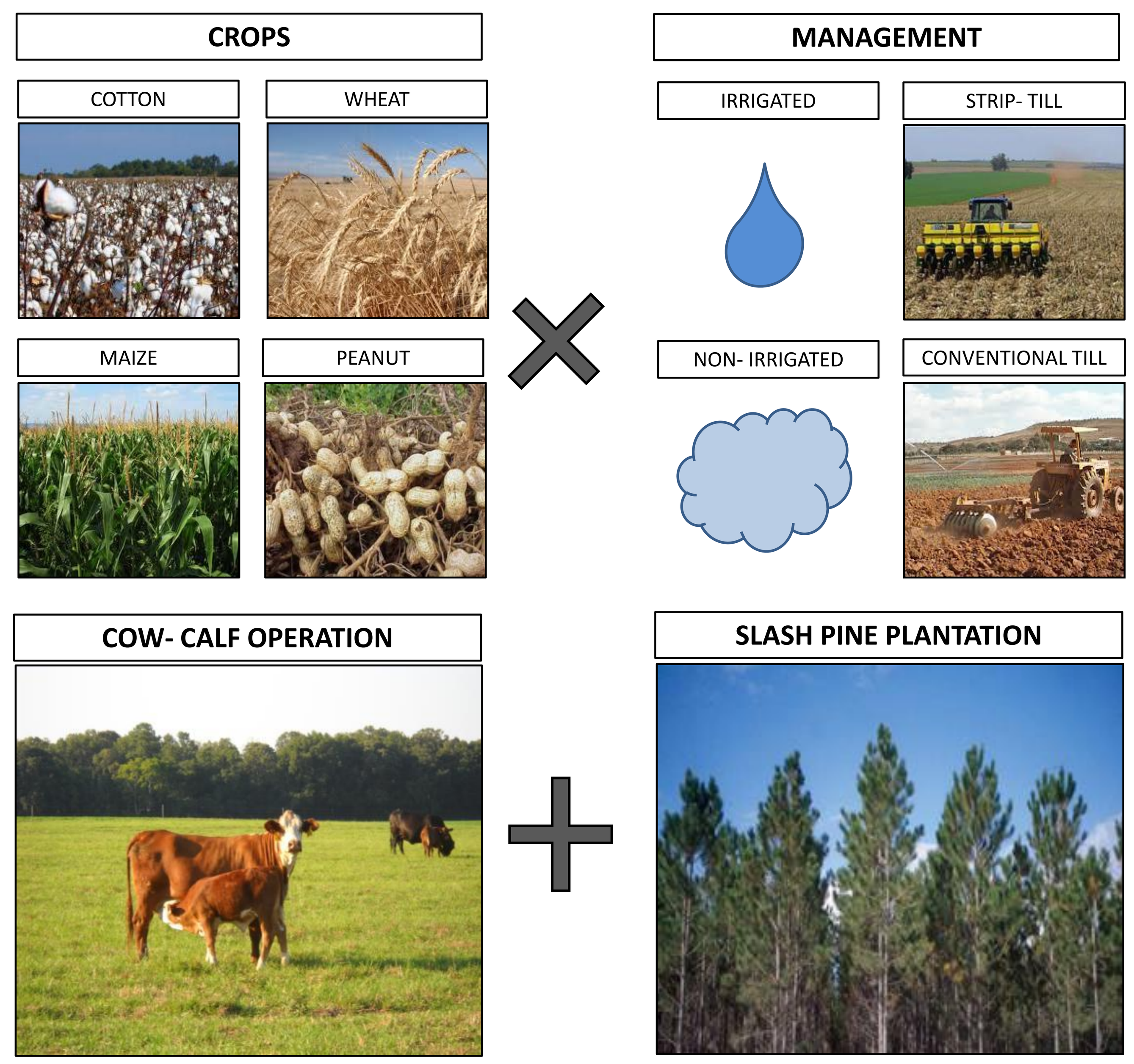


Figure 2. Farm activities in the hypothetical farm.

Results and Discussion

Results (Figure 3) indicated that GHG from conservation tillage are lower than conventional tillage, generally due to less use of machinery. Lal (2004b) observed that just by decreasing the use of machinery through converting from conventional till to no-till farming systems reduces emissions by 30 to 35 kg C ha^{-1} per season.

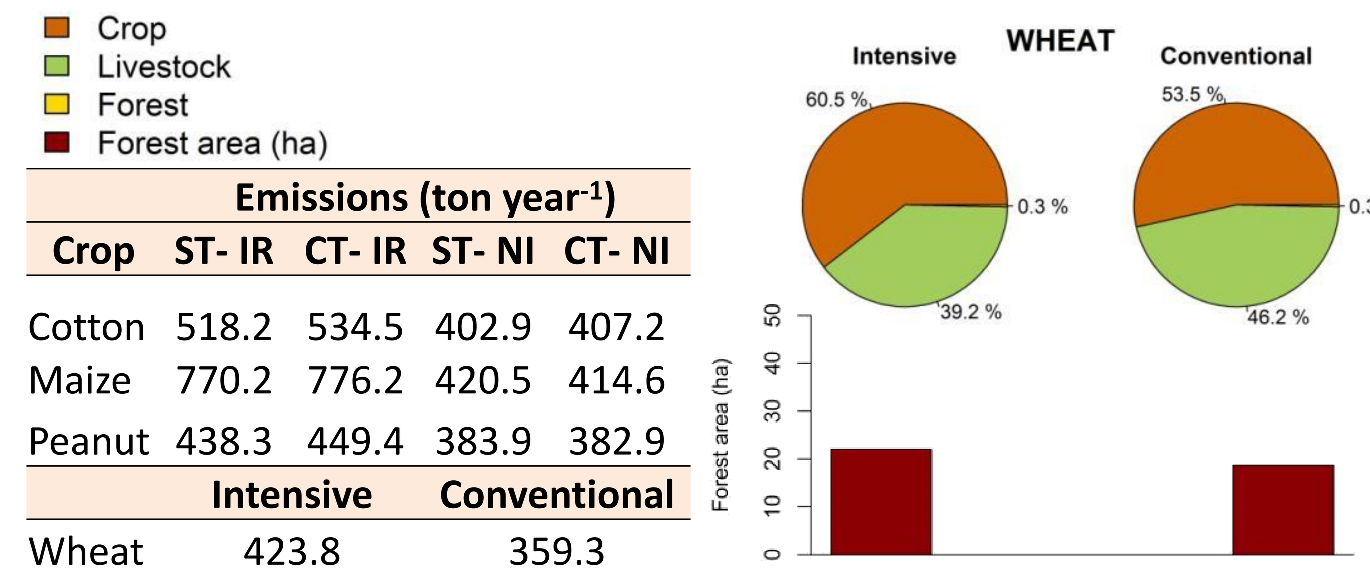
Irrigation increased all crop yields, but it also resulted in more GHG emissions. These emissions were due to a high fuel and electric energy consumption associated with the fact that the US's energy matrix is from coal and natural gas (EIA, 2013). In general, emissions per unit crop produced of irrigated crops were lower than of non-irrigated crops. Methane emissions from enteric fermentation were the most important source of GHG in the calf-cow operation simulation. In the United States, forest plantations could be established on marginal agricultural land to avoid interference with food production (McKinley et al., 2011).

Conclusions

Farms that integrate crops, livestock and forest plantations, when well managed, present higher adaptation to climate change and have potential to mitigate GHG emissions. In general, more intense systems that include the use of irrigation and the adoption of no- till had lower emissions per product.

The use of forest plantations can contribute to offset GHG emissions from agriculture and animal production and is a good alternative to diversify agricultural production systems.

Crop	Emissions (ton year^{-1}) ST- IR	CT- IR	ST- NI	CT- NI
Cotton	518.2	534.5	402.9	407.2
Maize	770.2	776.2	420.5	414.6
Peanut	438.3	449.4	383.9	382.9
	Intensive		Conventional	
Wheat	423.8		359.3	



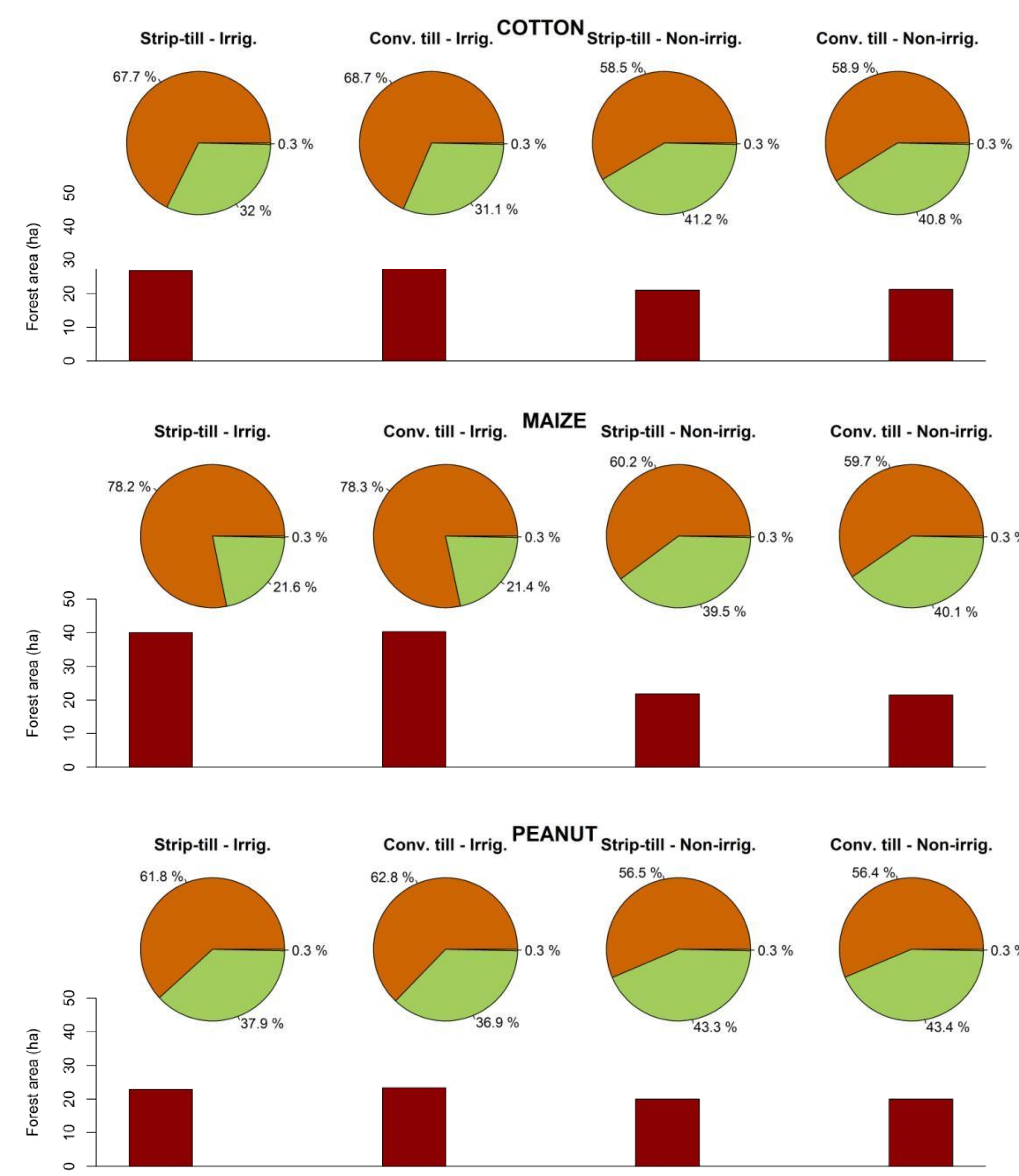


Figure 3. Total GHG emissions and forest area for different scenarios.

Acknowledges

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