

Carbon footprint of drip vs. flood irrigated cotton (*Gossypium hirsutum* L.) in NW China

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Background

- Agriculture suffers from and contributes to global climate change at the same time
- Cotton is one of the world's most important agricultural trade commodities
- Important for rural economies but intensive production with high environmental externalities
- In Xinjiang, China, about 10% of global cotton is produced
- Drip irrigation was introduced recently as a major innovation in cotton production



Fig. 1. Images of conventional flood irrigation (left) and new drip irrigation (right) conducted in Chinese crop production

Aims

- Assess the status quo climate change impact of farmers' cotton production in Xinjiang, China
- Compare conventional flood irrigation and new drip irrigation regarding GHG emissions per unit land and harvest product

Materials and methods

- Farm survey to obtain detailed crop management data, including all material and energetic inputs
- Stratified random sampling of farms along Tarim river
- 280 surveyed farms in total; data of 240 farms available for the present analysis (115=drip; 125=flood)



Fig. 2. Farm survey conducted with the help of Han Chinese and Uighur University students (left); location of the study region in China (right)

Materials and methods (cont.)

- Partial life-cycle-analysis (LCA) conducted to assess climate change impact of each individual farmer's cotton production

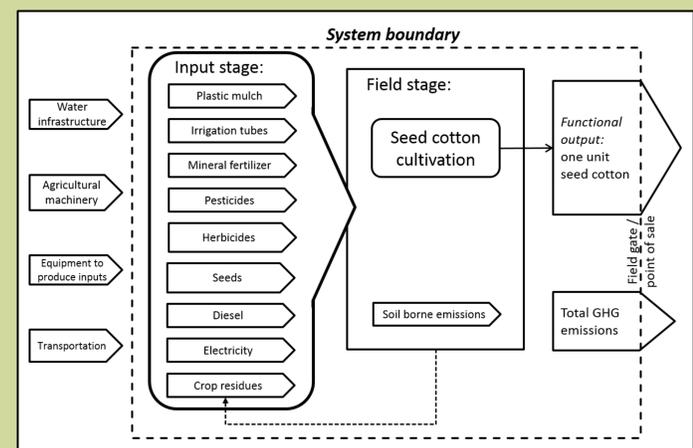


Fig. 3. System description of the applied LCA approach

Results and Discussion

- Strong heterogeneity among individual farmers' performance
- Drip irrigated cotton causes significantly higher emissions per unit land compared to flood irrigated cotton

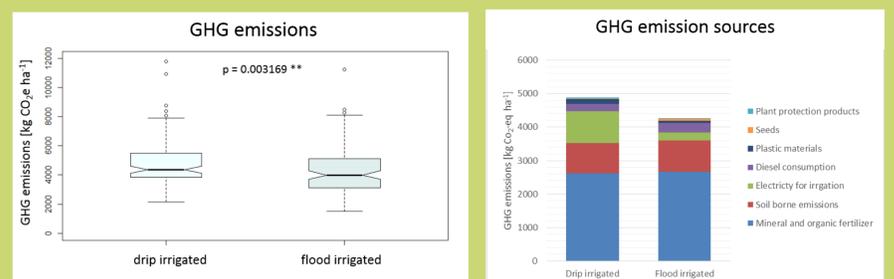


Fig. 4. Boxplots of GHG emissions of farmers' cotton production under drip (N=115) and flood irrigation (N=125) (left) and contribution of different emission sources to total GHG emissions (right)

- Fertilization and soil borne emissions are major contributors
- Higher emissions in drip vs. flood irrigated production stem from higher energy requirements and plastic materials

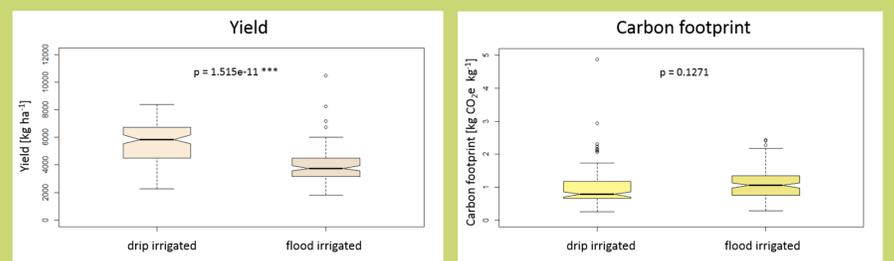


Fig. 5. Boxplots of yields (left) and carbon footprint (right) of farmers' cotton production under drip (N=215) and flood irrigation (N=225)

- Production under drip irrigation realizes significantly higher seed cotton yields compared to flood irrigated production
- No significant difference in carbon footprint of drip vs. flood irrigated cotton ($\bar{\phi}$ drip 0.99 kg CO₂e kg⁻¹ vs. $\bar{\phi}$ flood 1.09 kg CO₂e kg⁻¹)

Conclusions

- Higher yields under drip irrigation overcompensate for higher GHG emissions per unit land
- Taking limited land resources into account, drip irrigation should be promoted as a climate change mitigation measure

