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The carbon footprint of cotton production in Xinjiang, 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)

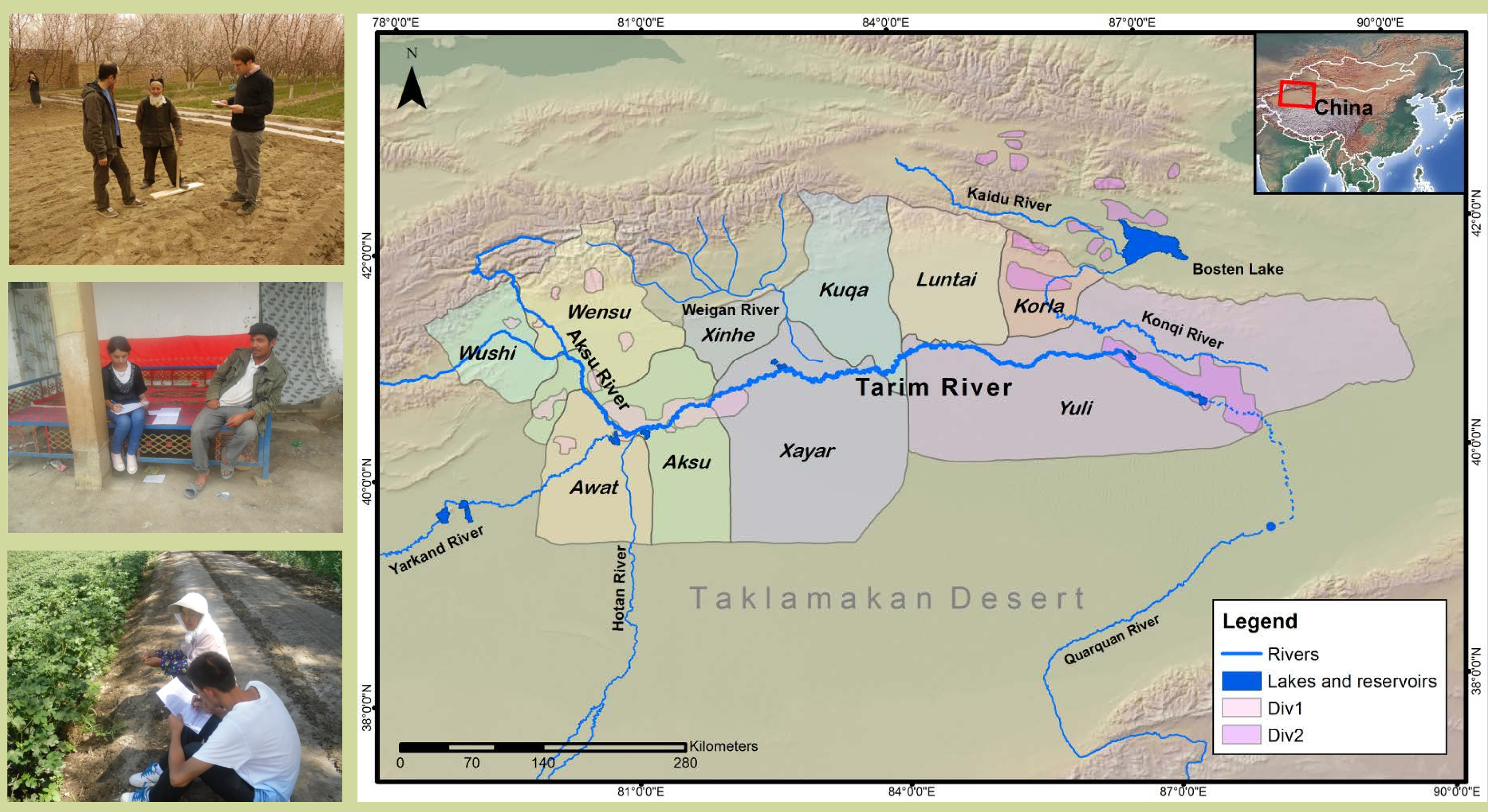

Fig. 2. *Farm survey conducted with the help of Han Chinese and Uighur University students (left); location of the study region in China (right)*

Materials and methods (*cont.*)

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

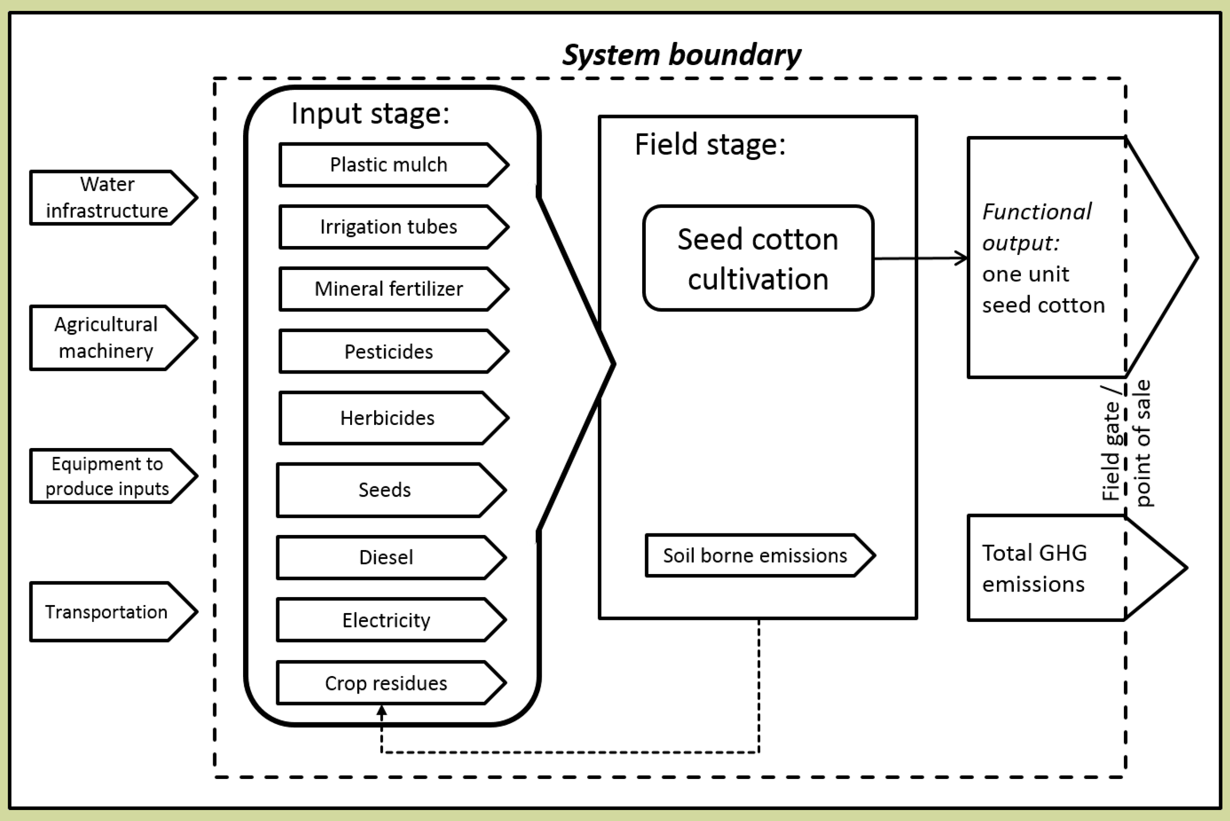

Fig. 3. *System description of the applied LCA approach*

Results and Discussion

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

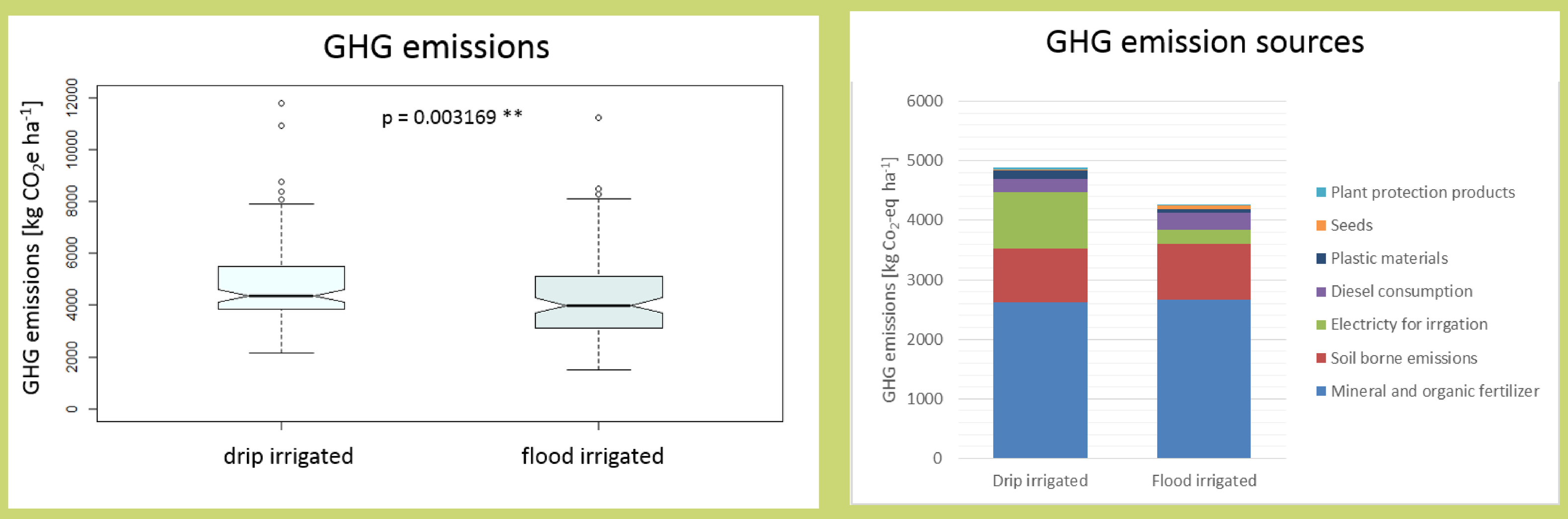

Fig. 4. *Boxplots of GHG emissions of farmers' cotton production under drip (N=115) and flood irrigation (N=125) (left) and contribution of different emission sources to total GHG emissions (right)*

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

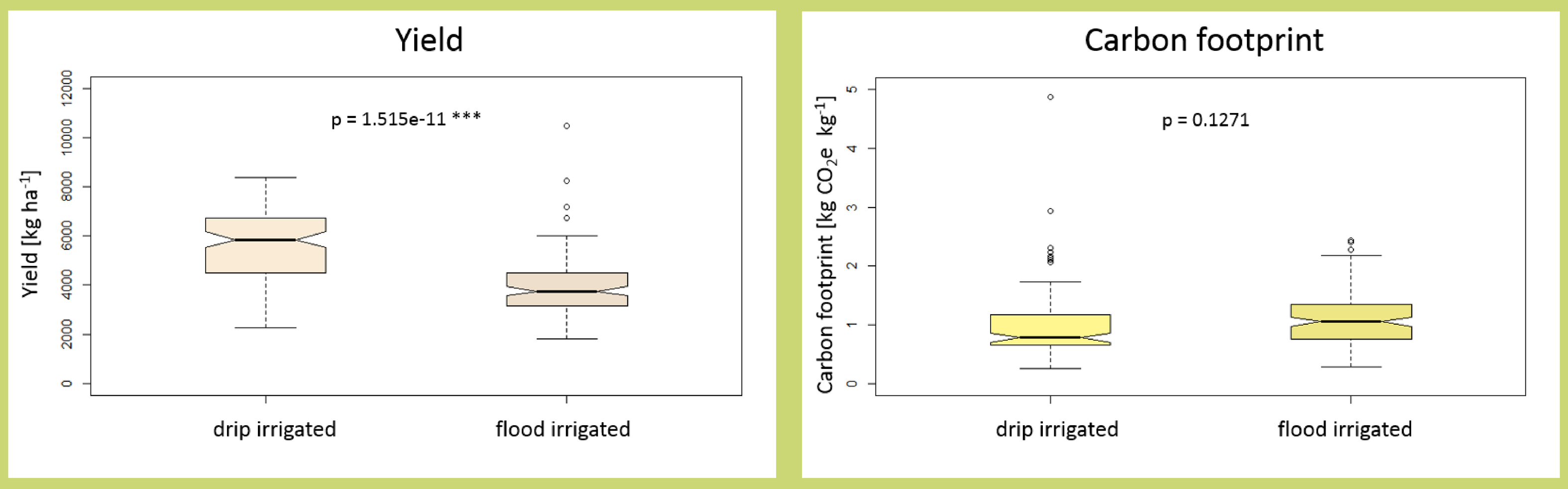

Fig. 5. *Boxplots of yields (left) and carbon footprint (right) of farmers' cotton production under drip (N=215) and flood irrigation (N=225)*

- 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 (ø drip 0.99 kg CO_2e kg^{-1} vs. ø flood 1.09 kg CO_2e 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