Use of crop modelling to assess climate risk management for family food self-sufficiency in southern Mali

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Introduction

Climate change will adversely affect food production in developing countries where a large fraction of the population already faces food insecurity (Lobell and Burke, 2008). This study aimed to better understand future climate change, its impact on crop production and the adaptation options in southern Mali. We quantified the consequences for food self-sufficiency of different types of smallholder farmers.

Materials and Methods

We used long-term time series of future climate data for the Sudano-Sahelian zone of Mali coupled with the Agricultural Production Systems sIMulator (APSIM) model to analyse climate change impacts on future cereal production. We analysed changes for the 4.5 Wm^{-2} and 8.5 Wm^{-2} radiative forcing scenarios (rcp4.5 and rcp8.5) and their effects on maize and millet yield. We used data on maize and millet from a field experiment conducted over three consecutive growing seasons from 2009 to 2011 at N'Tarla (Traore et al., 2014). The impact of future climate change on smallholder family food self-sufficiency was evaluated based on the balance of total energy produced and required at the household level. For the farm type adaptation options we assumed that the large farm type would apply the recommended fertilizer rate and keep the current early planting practice. The medium and small farm types would also apply recommended fertilizer rates and respectively plant early and mid-way between early and late in the growing season.

Results and Discussion

Under the current climate conditions, the food needs of the large and medium farms were satisfied by on-farm production while the small farm type did not achieve this (Table 1). Under future climate and current cropping practices, food availability was reduced for all farm types, but large farms still achieved food self-sufficiency. The medium farms dropped below the self-sufficiency threshold and small farms experienced a further decrease in food self-sufficiency. Under future climate conditions, large farms increased their food self-sufficiency status by applying recommended fertilizer rates. Medium farms raised food self-sufficiency above 100% by advancing planting from the current medium date (D2) to early planting (D1).

Applying the recommended fertilizer rates in combination with early planting further increased food production, whereas applying recommended fertilizer rates without earlier planting was insufficient to reach food self-sufficiency. For small farms, planting earlier and/or applying the recommended fertilizer rates did not suffice to achieve food self-sufficiency under future climate conditions.

Table 1: Future climate change impact on the food self-sufficiency (% kcal) of large, medium and small farm

	Cropping practice		Climate	Food selfsufficiency
Large farm	Current practice		Baseline	176
			rcp4.5	152
			rcp8.5	146
	Adaptation option	Fertilizer	rcp4.5	206
			rcp8.5	204
Medium farm	Current practice		Baseline	103
			rcp4.5	87
			rcp8.5	85
	Adaptation option	F2*D1	rcp4.5	141
		D1		126
		F2		94
		F2*D1	rcp8.5	139
		D1		124
		F2		93
Small farm	Current practice		Baseline	41
			rcp4.5	40
			rcp8.5	39
	Adaptation option	F2*D2	rcp4.5	46
		D2		40
		F2		40
		F2*D2	rcp8.5	45
		D2		37
		F2		39

Conclusions

To achieve family food self-sufficiency in southern Mali current cropping management strategies need to be improved. Early planting is an important option to achieve food self-sufficiency for the medium farms, but was not considered feasible for the small farm.

Acknowledgements

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References

Lobell, D.B. and Burke, M.B. (2008). Why are agricultural impacts of climate change so uncertain? The importance of temperature relative to precipitation. Environment Research Letters, 3: 8.

Traore, B. et al., (2014). Evaluation of climate adaptation options for Sudano-Sahelian cropping systems. Field Crops Research, 156: 63-75.