

The sensitivity of agricultural production to a plausible envelope of changes in climatic conditions in South Africa

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What is agriculture's possible sensitivity to future anthropogenic changes in climatic conditions in South Africa? We used algorithms based on historical data (1970 - 2006) that provides an estimate of the sensitivity of agriculture's net profit to a wide range of plausible changes in temperature and rainfall (Blignaut et al. 2009). These algorithms have been applied to South Africa's Second National Communication to the UN Framework Convention on Climate Change (SNC 2010) envelope of climate uncertainty, capturing 80% of the uncertainty range on both rainfall and temperature as reflected in climate scenarios generated from 10 General Circulation Models. These were presented in the SNC for the period 2046 – 2065 relative to 1971 – 1990 averages.

In most cases the results, shown in Table 1, show a negative impact of projected climate change on the estimated net profitability of intensive commercial agricultural production, expressed in 2010 values. Field crops seem to be the most sensitive to changes in climate. Given the three climate scenarios analysed the plausible range of the loss in net income from intensive field cropping is between R759mil and R3,9bil. This would constitute a projected loss of between 12% and 66% in total net income. The results would furthermore suggest that the Free State and the North-West Provinces are the most sensitive to these changes. The results presented here indicate that the effects of the expected temperature rise would likely far outweigh the effect of any anticipated rise in rainfall.

Field crops are more sensitive to changes in climate conditions as these activities are much more biased towards dry-land agriculture than is the case for horticulture and animal husbandry. The scope for allocating South Africa's limited water resources to an increase in irrigation agriculture is very limited due to the many demands placed on the country's water resources.

These results indicate clearly that agriculture's net profit seems to be extremely sensitive to anticipated long-term changes in climatic conditions if these are not urgently mitigated through international efforts to reduce greenhouse gas emissions. This implies that significant adaptation would be required, including improved, integrated natural resource management, especially catchment management, and the application of conservation and biological agriculture principles. Conservation of the soil resource to i) act as a store of water, and ii) prevent erosion during high rainfall events would be critical. Investment into the conservation and restoration of our country's natural capital would yield important returns, especially in terms of food security. Restored and well-managed natural capital is necessary to ensure well-functioning ecosystems, which is essential for sustaining productive farmlands.

Adaptation responses are relevant at individual farm level, on a catchment level, and on a national level. While farm-level interventions can be made by farmers themselves, co-operative effort and management is necessary for the higher levels of management and policy intervention.

Table 1: The impact of climate change on net profit by ~2050 (in Rand millions), with negative numbers indicating a drop in profits in three agriculture sub-sectors. The 10th, 50th and 90th percentile changes combine worst, median and best-case projected impacts of temperature and rainfall on agricultural sub-sectors that were projected at the provincial level.

	10 th percentile			Median			90 th percentile		
	Field crops	Horticulture	Animal husbandry	Field crops	Horticulture	Animal husbandry	Field crops	Horticulture	Animal husbandry
Western Cape		-850			-297			24	
Eastern Cape			-386			-246			-97
Northern Cape			-303			-212			-121
Free State	-1 780			-891			-181		
KwaZulu-Natal	-645			-433			-200		
North West	-812		-543	-442		-419	-175		-312
Gauteng			-800			-447			-227
Mpumalanga	-663	-101		-395	-54		-202	-20	
Limpopo		-437			-72			155	
Total	-3 902	-1 389	-2 034	-2 161	-423	-1 325	-759	159	-760
% of net 2010 income	-66%	-32%	-31%	-37%	-10%	-21%	-12%	3,5%	-11%

Source: Own analysis based on the predicted change in rainfall and temperature as per Table 1 and the algorithms developed in Blignaut et al. (2009).

Note: Empty cells refer to those incidences where Blignaut et al. (2009) could not find statistically significant relationships, i.e. the impact of rainfall and temperature change on field crops in the Western Cape.

References

- Blignaut, J., L. Ueckermann, and J. Aronson. 2009. Agriculture production's sensitivity to changes in climate in South Africa. *South African Journal of Science* **105**:61-68.
- SNC. 2010. *South Africa's Second National Communication to the Framework Convention on Climate Change (draft for public comment)*. Dept of Environmental Affairs, Pretoria.