Available online at www.sciencedirect.com
ScienceDirect
Agriculture, Ecosystems and Environment 126 (2008) 24–35
Agriculture Ecosystems & Environment
www.elsevier.com/locate/agee

Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa: An essential first step in adapting to future climate change?

P.J.M. Cooper [a,*], J. Dimes [c], K.P.C. Rao [a], B. Shapiro [b], B. Shiferaw [a], S. Twomlow [c]

[a] *International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), P.O. Box 39063-00623, Nairobi, Kenya*
[b] *International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502-324, India*
[c] *International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), P.O. Box 776, Bulawayo, Zimbabwe*

Available online 4 March 2008

Abstract

Rain-fed agriculture will remain the dominant source of staple food production and the livelihood foundation of the majority of the rural poor in sub-Saharan Africa (SSA). Greatly enhanced investment in agriculture by a broad range of stakeholders will be required if this sector is to meet the food security requirements of tomorrow's Africa. However, production uncertainty associated with between and within season rainfall variability remains a fundamental constraint to many investors who often over estimate the negative impacts of climate induced uncertainty. Climate change is likely to make matters worse with increases in rainfall variability being predicted. The ability of agricultural communities and agricultural stakeholders in SSA to cope better with the constraints and opportunities of current climate variability must first be enhanced for them to be able to adapt to climate change and the predicted future increase in climate variability. Tools and approaches are now available that allow for a better understanding, characterization and mapping of the agricultural implications of climate variability and the development of climate risk management strategies specifically tailored to stakeholders needs. Application of these tools allows the development and dissemination of targeted investment innovations that have a high probability of biophysical and economic success in the context of climate variability.

Keywords: Current climate variability; Climate change; Sub-Saharan Africa; Rain-fed farming; Climate risk management

1. Introduction

The impact of escalating human activity on greenhouse gas emission, global warming and changes in global climate patterns is almost certainly the most discussed issue of the first decade of the 21st century. And it is being discussed worldwide at all levels of society. From global, regional and national institutions through to development agencies and down to private citizens and to farmers in Africa.

In 2001, the Intergovernmental Panel for Climate Change (IPCC, 2001) provided strong evidence of accelerated global warming. In Paris in February 2007, they released their most recent assessment which dispersed beyond any reasonable doubt the link between human activity and global warming. In spite of the growing consensus amongst climate experts concerning the emerging reality of climate change, predicting the exact rate, nature and magnitude of changes in temperature and rainfall is a highly complex scientific undertaking and there currently remains considerable uncertainty with regard to the final outcome of climate change and its impact (IPCC, 2007). This is illustrated for regions of sub-Saharan Africa (SSA) in Table 1. The table presents the summary output of 21 General Circulation Models used by IPCC in their latest report to predict the annual changes in temperature and rainfall that will occur by

* Corresponding author. Tel.: +254 20 722 4568.
E-mail address: p.cooper@cgiar.org (P.J.M. Cooper).

0167-8809/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.agee.2008.01.007

Table 1
Regional predictions for climate change in Africa by the end of the 21st century

Region	Season	Temp. Response (°C)					Precipitation Response (%)				
		Min	25	50	75	Max	Min	25	50	75	Max.
West Africa	DJF	2.3	2.7	3.0	3.5	4.6	-16	-2	6	13	23
	MAM	1.7	2.8	3.5	3.6	4.8	-11	-7	-3	5	11
	JJA	1.5	2.7	3.3	3.7	4.7	-18	-2	2	7	16
	SON	1.9	2.5	3.3	3.7	4.7	-12	0	1	10	15
	Annual	1.8	2.7	3.3	3.6	4.7	-9	-2	2	7	13
East Africa	DJF	2.0	2.6	3.1	3.4	4.2	-3	6	13	16	33
	MAM	1.7	2.7	3.2	3.5	4.5	-9	2	6	9	20
	JJA	1.6	2.7	3.4	3.6	4.7	-18	-2	4	7	16
	SON	1.9	2.6	3.1	3.6	4.3	-10	3	7	13	38
	Annual	1.8	2.5	3.2	3.4	4.3	-3	2	7	11	25
Southern Africa	DJF	1.8	2.7	3.1	3.4	4.7	-6	-3	0	5	10
	MAM	1.7	2.9	3.1	3.8	4.7	-25	-8	0	4	12
	JJA	1.9	3.0	3.4	3.6	4.8	-43	-27	-23	-7	-3
	SON	2.1	3.0	3.7	4.0	5.0	-43	-20	-13	-8	3
	Annual.	1.9	2.9	3.4	3.7	4.8	-12	-9	-4	2	6

IPCC (2007).

the end of the 21st century. Maximum and minimum predictions of change are given together with the 25, 50 and 75 quartile values from the 21 GCM's. Whilst all models agree that it will become warmer, the degree of warming predicted is quite variable. However, with regard to the %changes in rainfall amounts, the uncertainty is considerably greater and in many instances models do not even agree on whether changes in rainfall will be positive or negative. Regions in which the middle half (25–75%) of the model prediction distribution is of the same sign is shaded grey. Whereas there appears to be a consensus predicted trend of wetting in East Africa and of drying in the winter rainfall regions of Southern Africa, the position is much less clear in West Africa.

However, whilst the exact nature and extent of the impacts of climate change on temperature and rainfall distribution patterns remain uncertain, most key investors and stakeholders in agricultural development in the Third World have agreed that it is the poor and vulnerable who will be the most susceptible to changes in climate as they occur. This is particularly true for those communities in sub-Saharan Africa who rely largely or totally on rain-fed agriculture or pastoralism for their livelihoods. Such communities, already struggling to cope effectively with the impacts of current climatic variability, will face a daunting task in adapting to future climate change. Whilst rural communities are the primary 'investors' and risk-takers in rain-fed production, there are also a wide range of associated support agents upon whose strategies, decisions and operations they often depend. Farmers and agricultural stakeholders will need to adapt their tactical and strategic planning to these evolving climate risks, but given the magnitude of the existing poverty, food security, environmental and health challenges that are faced in sub-Saharan Africa, adaptation to climate change should not and cannot be divorced from those current development priorities.

In this paper we suggest that enhancing the ability of such rural communities and associated stakeholders to cope better with the constraints and opportunities of present day climatic variability is, in fact, a necessary 'dress rehearsal' for adapting to future climate change.

2. Rain-fed agriculture in sub-Saharan Africa will remain vital for food security

Recent reviews have considered an impending global water crisis in the context of continued population growth and predicted climate change. They suggest that the projected trends in world population growth and dynamics will place substantially greater multi-sectoral demands on water, leading to greater competition between sectors for an increasingly limited supply of abstracted water (Cosgrove and Rijsberman, 2000). In Africa specifically, the projected combined impacts of climate change and population growth suggest an alarming increase in water scarcity for many countries, with 22 of the 28 countries considered likely to face water scarcity or water stress by 2025 (UNECA, 1999). This in turn will curtail the ability of irrigated agriculture to respond to the expanding food requirements of tomorrow's Africa. In contrast to the aspirations of the Millennium Development Goals, this raises the specter of a worsening food security crisis (Rosegrant et al., 2002a).

To reverse such a scenario, it has been concluded that much greater emphasis will have to be given to increasing the productivity of global rain-fed agriculture which currently provides 60% of the world's food. This is especially true in sub-Saharan Africa where currently nearly 90% of staple food production will continue to come from rain-fed farming systems (Rosegrant et al., 2002b). In such an endeavor, there are special challenges in Africa's rain-fed farming systems. It is here that some of the poorest and most