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Preface

International agricultural research and climate change: A focus on tropical systems

Global awareness and recognition of climate change has grown significantly over the past several years. Recent reports have pointed to the fact that, whilst there will be some winners, in general developing countries will suffer most from the negative impacts of climate change (IPCC, 2007; Stern, 2007). It has become obvious that the UNFCCC and its Kyoto Protocol will not be sufficiently effective to halt the increase of atmospheric greenhouse gas (GHG) concentrations, and we must now accept that the primary drivers of climate change are not going to stop. Mitigation efforts directed at these primary drivers will therefore only provide a partial softening of the effects of climate change. Local climates and terrestrial ecosystems will change, in many cases threatening human livelihoods. Yet, even as climate changes, food and fibre production, environmental services and rural livelihoods in developing countries must improve, not just be maintained. The *status quo* in the developing world is not acceptable. Developing countries are currently faced with urgent needs for development to improve food security, reduce poverty and provide an adequate standard of living for growing populations. Addressing these urgent and current development priorities must now be combined with a consideration of the impact of a changing climate on development policies and innovations.

Large percentages of the populations of developing countries depend upon agriculture for their livelihoods. Despite recent gains, more than 800 million people in the world are still chronically malnourished, and 1100 million live in absolute poverty (FAO, 1999). Large percentages of the populations in developing countries derive their livelihoods from agriculture and are therefore particularly vulnerable to climatic change. Populations of developing countries, particularly in South Asia and sub-Saharan Africa continue to grow at high rates, while productivity has stagnated or is decreasing in many grain producing areas of the world (Mann, 1997; FAOSTAT, 2007). To feed everyone adequately, world food production must double within the next 30 years (Cleaver and Schreiber, 1994). But, in the context of growing populations and an emerging global crisis in the availability of abstracted water, the shortfall in domestic food and feed cereals production in the developing world is expected to widen from around than 100 million tons in 1997 to around 190 million tons in the year 2020 (Rosegrant et al., 2001). In many regions of the world, there will be a limited ability for new varieties and increased fertilizer use to further increase yields (Huang et al., 2002). On top of this, degradation of soil and water resources has reached alarming proportions (Vasil, 1998; Smaling et al., 1997) and will undermine future efforts to boost agricultural productivity.

Climate change is already affecting agriculture in developing countries negatively and this situation is likely to worsen (IPCC, 2007). Climate change will add additional stress to already overtaxed systems. The risk of losing the gains of the Green Revolution, which has largely eliminated the famines of the 1950s and 1960s, is real. For example, projections suggest that the South Asia summer monsoon will be delayed and become less certain, and that temperature increases will be most intense during the winter season (Lal et al., 2001). Several modelling studies that combine spatial analysis with an analysis of the physiological effects of changes in CO_2, rainfall and temperature have been done in South Asia to assess the impact of climate change on crop production (Aggarwal and Sinha, 1993; Rao and Sinha, 1994; Kropff et al., 1996; Berge et al., 1997; Saseendran et al., 2000; Aggarwal and Mall, 2002). These studies have shown a decrease in the growing season and yield of most crops as temperature increases. Such reductions were only partially offset by a positive response to increased CO_2 concentrations.

Climate change will also severely set back agricultural development in Africa. An exploratory analysis of maize production in the tropics by Jones and Thornton (2003) suggests that production will decline by 10% on average, but this figures masks large regional and country-level variations. It is clear that there will be winners and losers as climates change. For example, the Sahel and Southern Africa regions are projected to suffer disproportionately, while the East Africa highlands are likely to enjoy increased productivity. Additionally, climate induced changes must be considered in light of other stress factors in today's world

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including economic globalization, urbanization and its effect on rural labour and land availability, population growth and its effect on water and other resource availability, crop pests and diseases, land degradation and low soil fertility, poverty, diseases such as AIDS and malaria, etc.

In some instances, the impact of additional stresses to agriculture and rural livelihoods from climate change may be small in comparison to these other stressors. Additionally, the gains of adapting agriculture to climate change may not be realized if they are negated by other factors. For example, liberalized trading policies under the compulsion of international agreements may expose the newly adapted crops/agricultural products to open competition with products from areas that are not suffering from climate change stress. Examples of these types of problems are already available. Gains facilitated by agricultural research and development and other support systems for oilseed crops in dry areas and apple and flower crops in hill areas in India, were nullified once government trade policies allowed liberal imports of these products under open general license (Ramesh et al., 2003).

The climate change problem is presenting decision makers with a set of formidable complications. There are a considerable uncertainties, which are inherent in the complexity of the problem, such as: our inability to make region specific predictions of the rate, nature and extent of climate change—especially rainfall patterns, the threat of irreversible damage to ecosystems, a very long planning horizon, long time lags between GHG emissions and climate effects, wide regional variation in causes and effects, the global scope of the problem and the need to consider multiple greenhouse gases and aerosols. Yet, an ostrich strategy of waiting until all uncertainties regarding climate change have been eliminated would be very short-sighted and in fact, disastrous. Given the irreversibility of current change and the response time of the ocean–atmosphere system in global change processes, authorities across the world have accepted that we must act now to increase the quality and scope of our science-based understanding of the problem and in reaching global consensus on the policies that must be put in place to address the issue. In addition, much effort will be needed to integrate what is known about likely climate change into national development planning (Abeygunawardena et al., 2003). The value of better information about climate change processes, impacts, and the response to arrest these risks is great. By identifying the resources on which adaptation can be based we may contribute to the maintenance and strengthening of these resources, and recognize where vulnerability will be highest.

The Consultative Group for International Agricultural Research (CGIAR), a consortium of 15 international agricultural and natural resource management research centres, has been working on climate related research to help provide this information for several decades. This effort intensified in 1998, with the creation of the Inter-Centre Working Group on Climate Change to promote greater collaboration among centres. This special issue presents a cross section of climate related research from the Centres that was discussed during a CGIAR conference on climate change, organized in Nairobi in October of 2005. The special issue begins with several papers that provide global or regional syntheses of issues related to climate change vulnerability and adaptation. Subsequent papers cover a wide range of topics related to adaptation in tropical agricultural systems and the potential for tropical agriculture to contribute to climate change mitigation.

As the CGIAR launches a series of new initiatives on climate change, it is our hope that the body of work in this area will grow exponentially. We firmly believe that the resources that have been devoted to this topic are not commensurate with the magnitude of the problem. In 1850, the first Director of the newly formed Rothamsted Experimental station (Lawes, 1850) concluded his publication of crop water use by plants with the observation *" We are convinced, indeed, that however important and useful miscellaneous agricultural analyses may be, the interest and progress of agriculture would be more surely and permanently served if the great patron Societies were to permit their scientific officers a wider range of discretion and more liberal means for the selection and carrying out of definite questions of research"*. More than 150 years on, we would echo that call. It behoves both 'great patron Societies' of today and the scientific community to bring greater efforts to bear on this problem and generate the knowledge that will point the way forwards for sustainable development and policies to support these activities.

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