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Issues and Policy Direction to Combat the Effect of Climate Change on Agriculture and Economic Development in Sub Saharan Africa

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Abstract
In recent time, scholars have shown much interest on addressing the problems of climate change. This is because of its associated effects on social, economic and the environment. The threats of climate change are more severe in developing countries, partially due to geography. In addressing this situation and mitigating its multifarious effects, the government and these countries have evolved adaption and mitigating strategies. However, these efforts must go beyond good development policy, be proactive, and explicitly target the impacts of climate change and energy (biomass) developments on the poor. As the global food equation is changing as a result of energy shortage and climate change, the world is not only confronted with agriculture and energy policy issues, but also with broader social, environmental, and security issues. The needed response involves a combination of science, institutional, and policy innovations, which should be taken into account in global, regional, and national strategies, and should have three main elements. This paper provides a direction on the best possible means of achieving effective and sustainable policy measures in addressing the problems of climate change in sub Saharan Africa.

Introduction

Emissions of GHGs between 2000 and 2006 have increased on the average by 3.1 percent per annum, compared to 1.1 percent in the previous decade, and are likely to continue to grow rapidly in view of high economic growth and lack of effective mitigation strategies (Garnaut, Climate Change Review 2008). There is high confidence that natural systems are affected by changes in climate, especially by rising temperatures (IPCC 2007). The effects of climate change are heterogeneous and region-specific. Some positive effects of climate change such as CO2 fertilization of plants could contribute to increasing food production and security. However, impacts such as rising temperatures and increased frequency of extreme weather events put severe pressure on food availability, stability, access, and utilization. Climate change could lead to increased water stress, decreased biodiversity, damaged ecosystems, rising sea levels, and potentially, to social conflict due to increased competition over limited natural resources. Small-holder agriculture, pastoralist, forestry, and fisheries and aquaculture are among the systems most at risk (FAO 2008).

The threats of climate change are more severe in developing countries, partially due to geography. Many low-income countries are located in tropical and subtropical regions, which are particularly vulnerable to rising temperatures, and in semi-desert zones, which are threatened by decreasing water availability. By 2080, agricultural output in developing countries may decline by 20 percent due to climate change, while output in industrial countries is expected to decrease by 6 percent (Cline, 2007). Also due to climate change, yields in developing countries could further decrease by 15 percent on average by 2080 (Fischer et al. 2005). Taking into account the effects of climate change, the number of undernourished people in Sub-Saharan Africa may triple between 1990 and 2080. Climate change shocks also erode the long-term opportunities for human development and could exacerbate inequalities within countries (UNDP 2007).

This study will examine measures needed to achieve improve productive base and effective management of natural resources (e.g. land, water, soil nutrients, and genetic resources) and higher efficiency in the use of these resources and inputs for production. It is expected that, putting these mitigation strategies in place can be help efforts towards food security within the SSA where the challenge of poverty is on the increase.

Issues of climate change on agricultural development in sub saharan Africa

For the poor, agricultural production is both a source of food and a source of income. Climate change impacts the four key dimensions of food security – availability, stability, access, and utilization (Schmidhuber and Tubiello 2007). Availability of agricultural products is affected by climate change directly through its impacts on crop yields, crop pests and diseases, and soil fertility and water-holding properties. It is also affected by climate change indirectly through its impacts on economic growth, income distribution, and agricultural demand

(Schmidhuber and Tubiello 2007). In addition, stability of crop yields and food supplies is negatively affected by variable weather conditions. Physical, economic, and social access to food would be affected negatively by climate change as agricultural production declines, food prices rise, and purchasing power decreases. Last by not least, climate change poses threats to food utilization through effects on human health and the spread of diseases in geographical areas which were previously not affected.

Current responses to climate-change threats—particularly those affecting agriculture in developing countries and hence, the majority of the rural poor—underestimate the gravity of the situation. Although a considerable body of work has studied and projected the adverse consequences of climate change, research on how the negative effects for developing countries and food insecure people could be mitigated is still very limited. The existing climate risk management options can have substantial benefits for some cropping systems if climate change is moderate, but will not be efficient if climate change is severe (Howden et al., 2007). The existing human, physical, and institutional capacity in many developing countries is insufficient to evaluate and manage the emerging climate change risks. Poor communities and individuals often have no insurance coverage against extreme weather events, and the private sector insurance is little developed in developing countries.

Poor and food-insecure people have often failed to receive the benefits of current climate change science. The ability of the poor to take advantage of climate change mitigation and adaptation technologies is also linked to their education, cultural practices, skills, and access to financial assets, as well as to the existence of supporting institutions and the relevance and applicability of technologies to their particular needs. It is important to maximize small farmers' knowledge, which is often marginalized by large-scale efforts to promote agricultural production. Small farmers are often at a disadvantage due to economies of scale. Horizontal cooperation schemes and scale-neutral technologies are some of the ways to overcome these barriers for small farmers. The costs to adapt to climate change can also include opportunity costs if new technologies and land use practices are changed, and can reduce farm incomes. In this case additional financial incentives are needed to induce small farmers to adopt new climate change reduction methods. Also, small farmers need to be trained in new techniques such as extreme weather early warning systems.

Impact of climate change on cultivable land cereal production potential on currently irrigated land and production potential on current rain-fed grass/scrub/woodland

The total land area comprising grass, scrub and woodland in SSA is estimated at 988 million has with a production potential 0f 2.67 billion tones of biomass (Table 1). According to the HadCM3 climate change projection, the impact of climate change in 2080 would result in an increase in SSA's pasture production potential of about 2%. Southern Africa, with current pastures of around 162miilion ha, would lose approximately 14% of its cultivable land and 20% of its pasture production potential in 2080. Livestock is an important component of food consumption and of livelihoods in most SSA countries, and meat and dairy demand is projected to increase by more than threefold by the 2080s (Shah, 2008). The results highlight the need for grain-based livestock feed and this may not be viable in some SSA countries through domestic production alone.

Agriculture is part of the problem and part of the solution of the climate change problem. Land use change and agriculture add to nearly one third of greenhouse gas emissions, but they also offer opportunities for carbon mitigation through carbon sequestration and biofuel production. The expansion of agricultural production as an energy source has broad and complex implications. Biofuel production increases the linkages between the energy and agriculture sectors, influences and is influenced by political, social, economic, and environmental change, and impacts households, businesses, and the private sector (von Braun et al., 2008).

Biofuels have raised hopes for reducing greenhouse gas emissions, mitigating climate change on a global or regional scale, and reducing the environmental risks to food security. Yet, biofuel expansion also adds to the greenhouse gas emissions problem through the conversion of forest and grassland to energy crop production. With land-use change, increased world corn-based ethanol production doubles emissions over 30 years and increases green-house gas emissions for 167 years (Searchinger et al., 2008). For palm biodiesel produced in Indonesia or Malaysia, the payback period to the carbon debt from land conversion is 423 years (Fargione et al., 2008). Technologies expected to have positive environmental impact and decrease the competition for scarce natural resources, such as the ones producing biofuels from lingo-cellulosic materials and wastes, are still in the making.

On the positive side, biofuels could benefit poor people through raising agricultural incomes, creating additional rural jobs in crop harvesting and processing, and utilizing marginal lands and crop residues. The extent to which these potentials are realized depends on the farmers' ability to access to information and markets, produce at competitive prices and sufficient economies of scale, and afford new biofuel sources. However, economies of scale in ethanol production—at least to date—favor large scale farms, while the existing subsidy regimes and import restrictions undermine the comparative advantage of developing countries. New technology such as with sweet sorghum may change that pattern.

For developing countries and poor people, the competition between agricultural production for food and for energy also creates new food security risks in the four dimensions – availability, stability, access, and utilization. In terms of food availability, biofuels could unduly divert land and water resources, capital, and political attention, away from the production of food. In the largest ethanol producer, the United States, a third of the domestic corn produced is being used for ethanol production. Rising demand of biofuel feedstocks also puts strong upward pressure on agricultural commodity prices and thus, on access to food. Further, stability of food supplies is put at risk as volatile energy prices translate into larger food-price fluctuations, to which poor people have little capacity to adjust. Incorporating actual biofuel investment plans, IFPRI's global scenario analysis projects that biofuel expansion may result in price increases of 26 percent for maize and 18 percent for oilseeds by 2020. This increase in crop prices is also accompanied by a net decrease in calorie consumption in all regions. The largest decrease is in Sub-Saharan Africa, where calorie availability is projected to fall by more than 8 percent if biofuels expand drastically. In addition, the pressure biofuels put on water for household use could pose health risks and undermine food utilization (Searchinger et al, 2008).

At the same time, however, local biofuel production could provide cleaner and cheaper cooking and heating alternative fuels and have positive health consequences for the poor. Whether expanded biofuel production is an environmentally sustainable source of energy depends on the choice of feedstock, cultivation practices, technologies employed, and the security, trade, and environmental policies that are adopted. For example, current public policies, which support uncompetitive biofuel production with distorting subsidy regimes implicitly, act as a tax on basic food, which constitutes a large share of the expenditures of the poor (von Braun et al., 2008). Factoring in environmental and economic aspects, embarking on large-scale biofuel production with grain and oilseeds based technologies does not make sense at this time. Biofuel technology will be an important area for sharing innovations between industrialized countries and developing countries in the future that could serve global sustainability. As the majority of patents in biofuels are held by the private sector, this is also a promising area for public–private partnerships.

Policy direction

Agriculture is important for food security as it produces the food people eat; and (perhaps even more important) it provides the primary source of livelihood for 36 percent of the world's total workforce (FAO 2008). Preserving and enhancing food security requires agricultural production systems to change in the direction of higher productivity and also, essentially, lower output variability. In order to stabilize output and income, production systems must become more resilient, i.e. more capable of performing well in the face of disruptive events. More productive and resilient agriculture requires transformations in the management of natural resources (e.g. land, water, soil nutrients, and genetic resources) and higher efficiency in the use of these resources and inputs for production. Transitioning to such systems could also generate significant mitigation benefits by increasing carbon sinks, as well as reducing emissions per unit of agricultural product.

In achieving this, von Braun et al (2008) disclosed that a rapid, coordinated, and multidisciplinary response is needed to respond to climate change and other emerging risks. It should be adapted to location-specific circumstances and incorporate the effects on food security of non-climatic factors such as high energy prices, high food prices, and biofuel production. The approach should combine adaptation strategies, which reduce the vulnerability of poor people to climate change and other shocks, and mitigation strategies, which moderate the impact of climate change after it has occurred.

More fundamentally, policy direction for climate change mitigation and improved sustained food security and agricultural productivity must among other things include improved land management, adjustment of planting dates, and introduction of new crop varieties, while the mitigation options include improved energy efficiency and crop yields, and land management techniques to increase carbon storage (IPCC 2007). Building on the fundamentals of good development policy is essential but not enough to ensure food security under new climate change challenges and threats. On a broad scale, von Braun (2008) noted that the adaptation strategies that are extensions of good development policy include,

i) promoting growth and diversification of production and livelihood systems;
ii) investing in research and development, education and health;
iii) creating markets in water and environmental services;
iv) improving the international trade system;
v) enhancing resilience to disasters and improving disaster management; and
vi) promoting risk-sharing, including social safety nets and weather insurance.

Effective adaptation and mitigation strategies, however, must also go beyond good development policy, be proactive, and explicitly target the impacts of climate change and energy (biomass) developments on the poor.

As the global food equation is changing as a result of energy shortage and climate change, the world is not only confronted with agriculture and energy policy issues, but also with broader social, environmental, and security issues. The needed response involves a combination of science, institutional, and policy innovations, which should be taken into account in global, regional, and national strategies, and should have three main elements. These elements, von Braun et al (2008) stated as discussed below;

1. *A science and technology strategy*, for mitigating climate change and accelerating agricultural productivity to maintain and improve food security. Yet, investments in science and technology have been sorely neglected in recent decades. For climate change mitigation, the technological innovations needed include early warning systems for droughts, floods, and other natural disasters, better soil and water management, and seed varieties more resistance to adverse climatic conditions. For adaptation and long-term productivity, biodiversity should also be maintained and enhanced, for example through newly founded gene banks. Carbon sequestration, a process that removes carbon dioxide from the atmosphere, should be encouraged for mitigating the increase of carbon concentration. Also, more support should be given to developing clean bioenergy technologies that do not compete with food production.

To achieve long-term agricultural growth and build a more resilient food system that can meet ongoing and future challenges, developing country governments should also increase their medium- and long-term investments in agricultural research and connect to international science and knowledge-sharing systems. In addition, new approaches to scientific partnerships should be developed and expanded. Co-funding and cooperation among public institutions, foundations, and private enterprises should play an important role in building and advancing the scientific base.

2. *Markets and trade policy strategy*, which calls for global institutional arrangements of carbon and biofuels trading, as well as micro-level design of markets in the two sectors. As a first step, developed countries should eliminate domestic biofuel subsidies and open their markets to biofuel exporters for biofuels from sustainable production. In view of the high food prices, measures to make more agricultural products available for food and feed include freezing biofuel production at current levels, reducing it, or imposing a temporary moratorium for biofuels based on grains and oilseeds. Transparent and equitable standards of carbon and biofuels trading are needed, including sustainability and performance based standards rather than technology-based standards that will quickly become outdated. Post Kyoto Protocol rules of access must change to include activities important for developing countries such as avoiding deforestation, soil carbon sequestration, and mitigating methane and nitrous oxide. The Clean Development Mechanism rules should be refined to encourage small farmer participation. In addition, existing regulations which impose high costs on developing carbon markets in poor countries should be changed and streamlined. Ongoing climate change initiatives, such as the Bali Action Plan, should lead to a new binding international climate change agreement with appropriate carbon-trading and carbon offset policies (e.g. cap-and-trade and carbon-tax instruments). A global emission trading system should include the right economic incentives for engaging small farmers in developing countries in climate change mitigation and adaptation. Farmers' organizations should cooperate at the national and international level to link small farmers to global carbon markets (IFAD 2008). Ensured by efficient contracts, the private sector and small farmers can engage in mutually-beneficial projects in carbon sequestration and decentralized bio-energy crop production.

3. *An insurance and social protection strategy for the food insecure poor*, to respond to the growing complexities of food system changes. To reduce the vulnerability of poor households to adverse climate and energy price shocks and to prevent new households from falling into poverty, there is an increased need to strengthen public and market-based social protection mechanisms. Examples of social protection policies include social safety nets (such as conditional or unconditional cash transfers, public works and school feeding programs, subsidies on items consumed by the poor, microcredit, and crop insurance), health insurance, and social security. In addition, the triggers of emergency agencies to respond to crises should be improved. New and innovative insurance mechanisms and private-public partnerships should also be introduced at a larger scale to expand coverage among the poor. Insurance and social protection must be adjusted to the individual circumstances of each country and should be supported by investment in rural infrastructure and services, and good governance. On an appropriate time scale, the actions needed to address the acute and long-run price issues may be broken down into an emergency package and a resilience package (von Braun et al., 2008).

Conclusion

In conclusion, the paper maintain that each country should develop and implement a viable national action plan, which takes into account future development paths, expected climate change impacts, and adaptation and mitigation costs. National governments can play a crucial role in assisting with climate mitigation and adaptation in five major ways: provide information and advice about climate risks and available strategies, provide guidance and training on design and implementation of measures, promote desirable adaptation measures through public policy, mandate adaptation to safeguard public health and safety and institutionalize adaptation capacity and policy and promote interdepartmental cooperation.

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Table 1: **Impact of climate change on cultivable land and production potential on current rain-fed grass/scrub/woodland**

	Current climate			HadCM3 A2 2080s			CSIRO A2 2080s		
	Area min ha	Prod min tons	Yield t/ha	Area	Prod	Yield % Change	Area	Prod	Yield % Change
Sub – Saharan Africa	988	2,670	2.7	0	2	3	-1	1	1
Eastern Africa	436	1,311	3.0	2	4	4	1	4	4
Middle Africa	216	866	4.0	-1	4	5	1	4	4
Western Africa	175	260	1.5	3	4	5	-5	-6	-6
Southern Africa	162	233	1.4	-14	-20	-19	-13	-15	-15
Developed	1,624	3,178	2.0	4	5	5	11	13	13
Developing	2,258	7,687	3.4	-1	1	1	1	2	3
World	3,882	10,865	2.8	0	2	2	4	5	5

Source: Fischer et al, 2008