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Agriculture at the Crossroads: Guaranteeing Food Security in a Changing Global Climate

For a large number of developing countries, agriculture remains the single most important sector. Climate change has the potential to damage irreversibly the natural resource base on which agriculture depends, with grave consequences for food security in developing countries. However, agriculture is the sector that has the potential to transcend from being a problem to becoming an essential part of the solution to climate change provided there is a more holistic vision of food security, climate-change adaptation and mitigation as well as agriculture's pro-poor development contribution. What is required is a rapid and significant shift from conventional, industrial, monoculture-based and high-external-input dependent production towards mosaics of sustainable production systems that also considerably improve the productivity of small-scale farmers. The required transformation is however much more fundamental than simply tweaking the existing industrial agricultural systems.

In most developing countries, agriculture accounts for between 20-60% of GDP, and employs up to 65% of the labour force, providing a livelihood for approximately 2.6 billion people globally. Despite increased world food production in the last few decades, the global effort to meet the MDG of reducing hunger by half by 2015 now appears beyond reach. In fact, the number of people suffering from chronic hunger has increased from under 800 million in 1996 to over one billion recently.

Global warming poses significant threats to agricultural production and trade, and consequently increases the risks of malnutrition and extreme hunger. Preliminary estimates for the period up to 2080 suggest a decline of some 15-30% of agricultural productivity in the most climate change-exposed developing country regions: Sub-Saharan Africa and South Asia. For some countries in these regions, total agricultural production could decline by up to 50%.

GHG emissions in agriculture

Agriculture accounts for about 13-33% of global GHG emissions, the former being confined to direct, the latter including indirect agricultural GHG emissions from agricultural inputs, equipment, food processing, transport, and land-use changes. As agriculture's share in global GDP is just about 4%, this suggests that agriculture is very GHG-emission-intensive. Agricultural emissions of methane and nitrous oxide (collectively accounting for over 90% of agricultural GHGs) grew by 17% in the period 1990–2005, about three times as fast as productivity increased in global cereals production, for instance. These GHG emissions are predicted to rise by a further 35-60% by 2030 in response to population growth and changing diets in developing countries, in particular towards the greater consumption of ruminant meats and dairy products, as well as the further spread of industrial farming.

Composition of GHG emissions in agriculture

The composition of GHG emissions in agriculture is very different from that of other industries. Carbon emissions account for only about 9%, whereas nitrous oxide (N_2O), mainly from fertilizer use, and methane (CH_4) emissions (related to fermentative digestion by ruminant livestock, residue/manure management and rice cultivation in flooded conditions) represent 46 and 45% respectively. In many developing countries, agriculture accounts for the majority or a major share of national GHG emissions.

Key driving forces of GHG emissions in agriculture

Land-use changes, primarily deforestation, mono-crop-based industrial agricultural practices, and industrial livestock production that rely on significant external inputs are the major driving forces of agricultural GHG emissions.

Deforestation has been largely driven by intensified cattle, animal feed, vegetable oil or pulp, and large scale bio-fuel production, mostly in pursuit of increased exports. Deforestation for fuel wood and subsistence agriculture by rural poor and landless has also played a role.

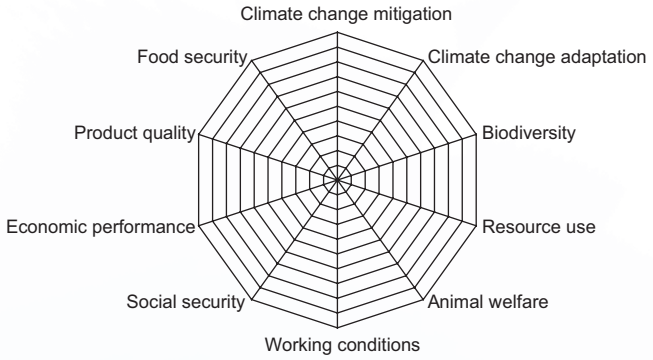
Today's advanced food production systems have become heavily dependent on the continuous investment in and use of energy-intensive machinery and fossil-fuel-based agricultural inputs. At present, industrial agriculture uses 2-3 times more fertilizers and 1.5 times more pesticides for the production of 1kg of food than it did 40 years ago. Industrial agriculture uses ten times more energy than ecological-agriculture, consuming on average 10 energy calories for every food calorie produced. This imbalance is only possible with cheap energy-based inputs linked to distorted prices.

Promising mitigation and adaptation strategies

Agriculture is a sector that has the potential to move from being part of the problem to becoming an essential part of the solution to climate change. It is however clear that a much more fundamental transformation is required than simply tweaking the existing industrial-agricultural systems. In essence, the key task is to transform the uniform, high external-input-dependent model of quick-fix industrial agriculture into a 'regenerative' agricultural system. Such a system (consisting of a mosaic of sustainable production methods) continuously recreates the resources it uses and achieves higher productivity and profitability of the

system (not necessarily of individual products) with minimal external inputs. Regenerative systems will marry local knowledge and seed/livestock varieties with modern agricultural techniques and extension services and give a pro-active role to small-scale farmers; it will be knowledge- and labour-intensive rather than agro-chemical and energy-input-intensive. Sustainable agricultural systems require a much more holistic approach, reflecting the multi-functionality of agriculture. Each feature of the system forms a web of interdependence and causality: a focus on just one or a few issues will not guarantee the stability of the system (see figure).

The multi-functionality of agriculture: a web of connections



Source: Matthias Stolze, FiBL.

Such sustainable production systems have the potential to quantitatively and qualitatively feed a 50% larger global population by 2050, in particular by substantially improving the crop yields of subsistence farmers in tropical regions where a rapidly growing population and food insecurity conditions are severe (studies indicate potential yield increases of between 60-80%).

There are significant secondary macro-economic benefits of investment in sustainable agriculture, and perhaps the most important is the 'local multiplier effect'. By locally sourcing inputs (e.g. labour, organic fertilizers, bio-pesticides etc.) a greater share of total farming expenditure remains in the local economy, replacing conventional procurement of externally sourced (and mostly imported) inputs and thus leveraging local economic development.

Post-harvest losses represent one of the single greatest sources of inefficiency in agriculture (often up to 80%, depending on food type and location). They could be reduced and world food supply increased by between 30-50% through the application of readily available technologies and management methods using minimal additional resources with little or no higher GHG emissions.

Also, integrating agricultural and (renewable) energy production offers several climate mitigation and adaptation opportunities. Localized food and renewable bio-energy systems can provide food and fuel security, based on a green circular economy that turns agricultural waste into biogas, animal feed and organic fertilizer.

Required national and international policy action

To effect such a fundamental transformation at the required scale, action at both the national and international levels should ideally go hand in hand, but governments in developing countries can still move ahead with effective measures at the national level if international-level progress is slow. This is all the more tempting as agricultural mitigation and adaptation have low or negative costs and offer many developmental co-benefits.

Developing country governments should focus on creating an enabling environment and changing the incentive structure as part of targeted agricultural and fiscal policies that strengthen sustainable agricultural practices. There are several main policy areas in this regard:

A. National-level measures

- Governments need to remove or modify existing tax and pricing policies that generate perverse incentives for sustainable production systems, such as the overuse of pesticides, fertilizers, water and fuel, or land degradation.
- Assuring stability in land management and tenure systems is central to successful sustainable agricultural policies. Agrarian reform should therefore continue to be at the top of governments' political agenda.
- It is imperative to significantly increase the share and effectiveness of public expenditure for agricultural development. In the last 30 years agriculture's share in total public investment in agriculture-dominated developing countries has declined from 7 to 4%. Policy-makers not only need to reverse this trend, but also target public investment carefully, putting resources into improving physical and R&D infrastructure, the linkages between farmers, and greater investment into extension education and services, primarily supporting sustainable, regenerative production methods.
- Financial constraints in agriculture remain pervasive, and they are costly and inequitably distributed, severely limiting smallholders' ability to compete. The demise of special credit lines to agriculture through public programs or state banks has left huge gaps in financial services.
- Strengthening the performance of producer organizations should also figure prominently on the agenda of governments.
- Adaptation measures are a priority for developing countries and should be supported by finance and technology transfer from developed countries.

B. Policy measures and challenges at the international level

- International development co-operation needs to refocus on agriculture, whose share as a proportion of total ODA flows declined sharply from a high of 18% in 1979 to 3-4% in recent years. More aid as well as longer-term development finance should be made available to strengthen the agricultural innovation and extension system for ecological farming methods and infrastructure.
- There needs to be a reform of international trade policies making them supportive of ecological agriculture. Apart from a real reduction of domestic support and export subsidies by developed countries, this should include improved market access for developing country producers and policy space to support the agricultural sector, allow the expansion of local food production and the use of effective instruments to promote food security, farmers' livelihoods and rural development.
- The expanding global market dominance of a small number of agro companies is increasingly problematic. The market share of the four largest companies (Monsanto, DuPont/Pioneer, Syngenta and Bayer Crop Science) oscillates around 60% for agrochemicals, 35% for seeds and 40% for biotechnology. These companies have a vested interest in maintaining an external-input-dependent, mono-culture-focused and carbon-intensive industrial approach to agriculture. Furthermore, international supply chains, often under the leadership of major food processors or retailers, need to redirect their sourcing policy from scale-focused, mono-crop production to diverse and integrated agriculture.
- Enhanced regional and international South-South co-operation could play a useful role in strengthening agricultural R&D and extension capacity. The establishment of regional centres of excellence, regional public research institutions and closer collaboration among existing research centres would be valuable steps in this direction.
- The process of developing appropriate methodologies for mitigation and adaptation strategies and measures is costly and requires multi-disciplinary expertise. There may therefore be a need for an international instrument that provides a global framework for action and support for agriculture, such as an IPCC equivalent for agriculture that would draw on the recommendations of the International Assessment of Agricultural Science and Technology for Development (IAASTD).

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