The Voice of OECD Business

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Agriculture and climate change

Issues for consideration

Introduction

As countries are seeking to meet and negotiate binding climate change targets, the contribution that agricultural production makes to anthropogenic greenhouse gas emissions is being considered by policy makers globally. There is therefore a clear need to find cost-effective ways to address agricultural emissions whilst considering agriculture's role in supplying food, feed, fuel and fibre. This needs to be done in a way that does not compromise other objectives, such as food security and poverty alleviation, both of which should be considered against the growing global population and the diminishing availability of agriculturally-productive land. At the same time, climate change will have significant impacts on agriculture, calling for an effective adaptation strategy in addition to mitigation policies. The negative effects of global warming, such as heat waves, storms, floods, changes to rainfall pattern, water availability in water-stressed areas and soil degradation, have potentially major implications for life essentials, i.e. food, water, land and the environment.

Business is committed to playing its role in addressing these major challenges, and many companies worldwide have already taken considerable action. In BIAC's view, the OECD Agriculture Committee can and should play an important role by fostering dialogue, providing analysis on climate change mitigation and adaptation options and formulating fact-based policy recommendations.

An urgent need for mitigation

Agriculture is a major source of global greenhouse gas emissions accounting for 13% of global anthropogenic emissions[1], in particular in the areas of methane and nitrous oxide. Without abatement measures, emissions are likely to climb, among others due to population growth and changing food consumption patterns. In order not to compromise other key challenges, such as global food security, it is essential to look for "win-win policies". Efficiency and cost-effectiveness of measures should be key considerations for policy

[1] IPCC Fourth Assessment Report (2007), Synthesis Report, Fig 2.1 on page 36 and associated text: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

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makers. Emissions reductions should be sought in sectors where abatement is more cost-effective as compared to other sectors.

Possible mitigation measures include a wide range of issues, such as improved farming techniques, minimum soil tillage, using "cleaner" energy, carbon sinks, conservation agriculture etc. However, many mitigation options entail additional costs to farmers, calling for cost-effectiveness to be given the highest attention. In BIAC's view, innovation will need to play a key role for mitigating emissions from agriculture. Innovation should be defined broadly, i.e. not only related to technology, but also services, farming practices and behaviour along the supply chain. In this context, the spread of technology and innovative approaches, including to developing countries, needs to be given the highest attention.[2]

Considering both adaptation and mitigation

All climate-sensitive systems of society and the natural environment, including agriculture, forestry, water resources, human health, coastal settlements, and natural ecosystems, will need to adapt to a changing climate or possibly face diminished productivity and health. Some degree of future climate change will occur regardless of how stringent future mitigation policies will be. Adapting to or coping with climate change will therefore become necessary in certain regions and for certain socioeconomic and environmental systems. Adaptation options in agriculture can involve a range of actions, such as investment in flood protection, planting different crops, early warning systems, etc. They need to include actions by producers, industry and policy makers. However, adaptation alone is not expected to cope with all the projected effects of climate change, and especially not over the long term as most impacts increase in magnitude.

Both mitigation and adaptation will need to be considered. Adaptation to climate change, which is particularly important in many developing countries, is now recognised as a complementary response to mitigation strategies. Particular attention must be paid to the interactions between climate change, energy and water, which are linked in many ways. One must emphasise the importance of the private sector in adaptation. Business investment, know-how and technology will be essential to respond to the challenge of adapting to climate change. Furthermore, business has experience in accounting for risk in long-term planning and investments and could share best practices in this area.

Already small changes in climate change can have significant impacts on agricultural productivity. Current variation in crop productivity and yields among different regions, are likely to become greater as the effects of climate change are felt by farmers. Preparing agriculture for adaptation should therefore go hand-in-hand with pro-active mitigation measures. Research is already being carried out in order to develop varieties of crop plants which can successfully grow under conditions of drought stress, water scarcity, heat shock and higher levels of water and soil salinity, as well as being inherently resistant to certain diseases and pests. While conventionally bred crops and currently-available genetically engineered crops, where appropriate, hold the potential to reduce CO_2 emissions and the use of tractor fuel, certain crops are being developed to make more efficient use of scarce

[2] See BIAC Paper: Innovation to Address Food Security (2009).

resources such as water and nutrients. This has the potential to result in more agricultural productivity and contribute to higher yields and better product quality. These would allow farmers to maintain high output even with less water, soil, and energy, thereby contributing to the development of best practices for environmental sustainability.

Innovation to address climate change

In this complex and dynamic scenario, where growing population levels and correspondingly growing demand for food and nutrition must be considered as a crucial aspect, a policy framework that fosters and adequately protects and rewards investment in research, innovation and technology is vital to successfully address the challenges posed by climate change. Innovation will play an essential role in both mitigation of emissions and adaptation to climate change as related to agriculture. Yield-increasing technologies, management practices and approaches can provide a significant contribution to environmental preservation by boosting the productivity of existing land under cultivation, foregoing the need to bring more land into production (i.e. avoid detrimental practices such as deforestation). Innovation and the spread of innovative technologies require among others, open markets, an enabling regulatory framework and the effective protection of intellectual property rights, including strong efforts, and a willingness of governments to adopt effective methods for sharing and disseminating knowledge and best practices, for example, by reinvigorating moribund agricultural extension provision.

While not an exhaustive list, the following examples illustrate the importance of innovation for addressing climate change:

- New crop varieties

Investment in new crop varieties to increase tolerance to water and heat stress will be essential. For example, the plant biotechnology sector can play a major part in helping to address the negative effects and consequences of climate change, especially with respect to greenhouse gas reduction, crop adaptation, and the protection of and increases in yield. Innovations in the field of nitrogen efficiency and water efficiency could also constitute important new tools for adaptation and mitigation. GM rice and canola plants, which use nitrogen more efficiently, are already available.

- Crop Protection

Protecting yields from weeds, pests and diseases is crucial to maintaining and potentially increasing agricultural productivity. The production of fruit and vegetable crops, vital for healthier global diets, is especially threatened by pest pressure and other climate change-related effects, such as drought. The responsible use of crop protection products as well as properly-implemented integrated pest management strategies are and will remain important instruments for combating pests and preserving harvests and the global food supply.

- Plant Nutrients/Fertilisers

Appropriate and responsible use of fertilisers and sustainable nutrients can make a contribution to helping plants capture more carbon, fostering higher yields and slowing the decline of soil organic matter. The emissions originating from fertiliser use by farmers should

be weighed against the net benefits of using fertilisers to increase agricultural productivity on the same amount of land, thus reducing the advent of land-use change and increasing the carbon content in soils. In addition, the industry works with farmer organisations to promote the use of fertiliser best management practices to simultaneously reduce emissions, increase soil organic matter and improve yields. Further research should be supported to increase nutrient use efficiency, such as the development of slow- and controlled-release fertilisers.

- Carbon Sequestration

Soil carbon sequestration will be an important mitigation strategy to reduce atmospheric CO_2 concentrations. The process of transferring atmospheric CO_2 into soil and biotic pools can enhance soil quality, increase agronomic productivity, improve quality of natural waters, and lower rates of anoxia (decrease in the level of oxygen) or hypoxia (dead water) in coastal ecosystems. Crops developed from biotechnology have a reduced need for ploughing or tillage, thus leading to fewer losses of CO_2 which is emitted when soil-carbon is oxidised through exposure to air.

- Soil Conservation

Conservation agriculture techniques such as low or no-till agriculture, made possible through the use of herbicides and herbicide-tolerant biotech crops in appropriate and carefully managed cases, prevents wind and water erosion and loss of ground moisture, improves soil biodiversity, has the potential to increase soil fertility, and reduce carbon emissions. In addition, by limiting soil disturbance and promoting a permanent soil cover, conservation agriculture can contribute to limiting emissions from agriculture by increasing soil carbon content and preventing erosion.

- Adjustments in Farm Practices:

The following soil and crop technologies can increase soil carbon sequestration: No-till (NT) farming with residue mulch and cover cropping; integrated nutrient management (INM), which balances nutrient application with judicious use of organic manures and inorganic fertilisers; various crop rotations (including agro forestry); use of soil amendments (such as zeolites, biochar, or compost); and restoration of degraded or desertified soils, which can be achieved through afforestation and reforestation. In addition, the development of prediction tool models and on-site diagnostics can optimise farm practises by minimising the inputs (fertiliser, water, agrochemicals) and maximising the yield.

- Adopting Best Production Techniques and New Technologies

The technology and knowledge is available to achieve significant reductions in emissions in natural-gas based ammonia production. For example, by improving the management of operations using best production techniques, one can reduce energy consumption and decrease direct GHG emissions, which carry the largest share of the industry's emissions.

- Insurance Mechanisms

Innovative insurance mechanisms should be explored to compensate rural communities and smallholder farmers in case of emergency. Africa is particularly vulnerable to climate

change because of its high proportion of low-input, rainfed agriculture, compared with Asia or Latin America. Exposure to rainfall variability also extends to livestock, which mostly depend on range and grasslands that are affected by environmental shocks, such as climate change.

- Innovative Water Management

Several steps can be taken to improve water management in the context of climate change and increasing strains on water resources. This will be to the overall benefit of agricultural production. For example, improvements can be made by transferring and implementing irrigation technology (such as localised irrigation systems, sensors to avoid over-irrigation, etc.) and rainwater harvesting, while crop technology to improve crops' ability to adapt to changing soil moisture conditions and release less water will be essential. At the same time, reaching innovative solutions for water financing and policy-making will be important for sustainable water management, as demonstrated in the comprehensive 2009 analysis carried out under the OECD Horizontal Water Programme. Re-use of urban wastewater and alternative water supplies (e.g. industrial wastewater recycling) for agricultural production can in cases also help to reduce water wastage.

- Extension

A key element in supporting agriculture's role is capacity building, dissemination of research knowledge and information. Extension programmes were originally conceived as a service to "extend" research-based knowledge to the rural sector in order to improve the lives of farmers. However, extension services are being dismantled or are often ineffective, particularly in developing countries. Extension can help farmers prepare for greater climate variability and uncertainty, create contingency measures to deal with exponentially increasing risk, and alleviate the consequences of climate change by providing advice on how to deal with droughts, floods, and so forth. Extension can also help with mitigation of climate change. This assistance may include providing links to new markets (especially carbon), information about new regulatory structures, and new government priorities and policies. Innovating and re-instating effective extension services will become more important than ever in a changing climate.

- Intensification of agriculture

While reducing agricultural energy intensity is overall desirable, it is important to keep in mind that for some countries, an intensification of agriculture may be more appropriate to avoid other adverse effects. Many developing country agricultural producers, in particular in Africa, see lower yields due to insufficient inputs, including modern farming equipment and fertiliser. Low productivity and poor soil health, if left unchanged, could lead to increased rates of deforestation, and therefore exacerbate rather than mitigate climate change.

- Reduced waste of agricultural produce

As well as "waste" in the field when yields are reduced by pests, diseases, weeds, climate or weather effects, much agricultural production is lost after harvest during transport or storage or in other parts of the food chain. Investment in technologies that ensure food is not wasted, but can be stored and transported efficiently to the increasingly-urban population of the world, is clearly needed. Investment in developing relatively small-scale low-cost drying,

packing, bottling, canning, etc, plants and machineries that can be operated in rural areas where electricity supplies and other infrastructure is not always reliable are needed. This will help ensure that food is not wasted, farmers have reliable markets for relatively high value products and small-scale businesses can be set up and run where they will help revitalise rural areas.

Implications for Water Resources

Climate change will affect the availability and use of water, and will amplify the competition for water resources. The climate-related changes to hydrological patterns are expected to increase, leading to high levels of uncertainty in water availability, and some regions will be far more affected than others. This will have a profound impact on agriculture, as approximately 70% of global freshwater is used for agriculture.

At the same time, population growth and changing food consumption patterns are expected to put further strain on water resources, as a doubling of food production is expected in the next 40 years, and global demand for meat is expected to increase by 50% between 2009 and 2025[3]. This will intensify the challenges facing water management in many countries, particularly in developing countries where agriculture is often one of the largest sectors of national economies. Addressing the water challenge will be of fundamental importance in addressing challenges to agriculture in the context of climate change.

Land Use Change

One-off, but huge emissions are associated with land use change, either from natural ecosystems to agriculture or within agricultural systems. Forests, peatlands and pasture all store large amounts of carbon, which is released when biomass is cleared and soils are cultivated or wetlands drained. The pressure to convert natural vegetation to arable land and low-intensity pasture and range land to higher-intensity crop land will increase as populations grow and climate change effects reduce yield or reliability-of-yield for many crops.

Sustainable Agriculture and Capacity Building

Sustainable farming meets environmental, economic, and social objectives simultaneously. Economic sustainability requires selecting profitable enterprises and undertaking comprehensive financial planning. Social sustainability involves keeping money circulating in the local economy, and maintaining or enhancing the quality of life of the farm family. Environmental sustainability involves keeping the four ecosystem processes (effective energy flow, water and mineral cycles, and viable ecosystem dynamics) in good condition. Every small decision can make a difference and contribute to advancing the entire system further on the "sustainable agriculture continuum." For example, promoting the responsible

[3] World Economic Forum Water Initiative discussion draft on: “The bubble is close to bursting: A forecast of the main economic and geopolitical water issues likely to arise in the world during the next two decades” – January 2009 – see http://www.weforum.org/pdf/water/WaterInitiativeFutureWaterNeeds.pdf .

use of agro-chemicals like modern synthetic pesticides, herbicides and other crop protection products can help propagate sustainable agriculture practices and address the challenges posed by climate change.

In this respect, capacity building is an essential overarching requirement, and generic capacity building at all levels is crucial. However, in particular in countries where agriculture is a predominant sector, generic capacity building has to go hand in hand with more targeted capacity building for science and technology in the agriculture sector to achieve tangible outcomes. The process of capacity building must be complemented by improved access to essential information, such as agronomic information, price and weather updates to allow farmers to apply their knowledge and support their capacity.

Similarly, technical advances in assembling data on biomass and soils, and transmitting and integrating them via ICT tools can help local agriculture. As losses to the environment can be triggered by unbalanced, irresponsible use of growth agents, fertilisers and excessive nutrient application, it is extremely important that farmers be taught how to implement sound agro-ecosystem management measures by means of targeted capacity building programmes. Educating farmers about technologies and practices for sustainable agriculture will therefore be essential. To facilitate these types of initiatives, it will be important to provide the necessary assistance to farmers.

Public-Private Partnerships

As mentioned above, capacity building will be a key requirement for addressing climate change. Public-private partnerships (PPPs) can play a key role in this area. Private partners can deliver a service in which the service delivery objectives of the government are aligned with the profit objectives of the private partners, while the government can specify the quality and quantity of the service it requires and can also provide payments to private partners.

Dialogue and partnership are important to increase the understanding of complex issues, such as technological change and raise awareness of the need for a broad base of action that needs to involve all partners. PPPs can also boost much-needed investment for improving sustainable agriculture. We encourage policy makers to facilitate business participation and recognise voluntary partnerships as an effective means to address climate change challenges.

The PPP model has been applied to help local governments and private businesses combine efforts and expertise to fight climate change and promote environmental sustainability, particularly in cases where available public funds and private financing are not sufficient to meet demand on their own. PPPs can help across the range of agronomic practices (conservation agriculture, conservative tillage, irrigation methods for saving water, etc), and in infrastructure improvements to facilitate small scale farmers' access to markets. While each PPP is unique, they need to be based on several principles: shared goals, shared and complementary resources, transparency, and shared risks and benefits.

A role for the OECD

Agriculture directly impacts the climate and is impacted by climate change. It should therefore be given due attention, both with regard to mitigation and adaptation, which should be closely linked. Further research is needed to more fully incorporate climate change considerations in agriculture. Such areas for further research include: promotion of cost-effective adaptation frameworks, assessment of mitigation options, promotion of innovation to address climate change, and changes in farming practise. Given the potential cost burden of mitigation and adaptation policies, it is essential to keep an economic focus in mind when seeking for environmental improvements. The OECD, as a multi-disciplinary organisation with economic focus and excellent skills in the area of climate change, food and agriculture as well as innovation, can play an important role in this area. BIAC looks forward to cooperating closely with the OECD for any further work in this area.