Global Greenhouse Gas Mitigation Potential in Agriculture – the way forward after Copenhagen

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There is very significant cost effective greenhouse gas mitigation potential in agriculture. The yearly mitigation potential in agriculture is estimated to be 4200, 2600 and 1600 Mt CO_2-eq. yr^{-1} at 100, 50 and 20 USD t CO_2-eq^{-1}, respectively. The value of greenhouse gases mitigated each year is equivalent to 420 000, 130 000 and 32 000 Million USD yr^{-1} for C prices of 100, 50 and 20 USD t CO_2-eq.$^{-1}$, respectively. From both a mitigation perspective, and from an economic perspective, we cannot afford to miss out on this mitigation potential.

The challenge of agriculture within the climate change context is two-fold, both to reduce emissions and to adapt to a changing and more variable climate. The primary aim of the mitigation options is to reduce emissions of methane or nitrous oxide or to increase soil carbon storage. The mitigation options therefore all in some way affect the carbon and/or nitrogen cycle of the agroecosystem. This often does not only affect the greenhouse gas emissions, but also the soil properties and the nutrient cycling. Adaptation to increased variability of temperature and rainfall involves increasing the resilience of the production systems. This may be done by improving soil water holding capacities through adding crop residues and manure to arable soils or by adding diversity to the crop rotations.

Though some mitigation measures may have negative impacts on adaptive capacity of farming systems, most categories of adaptation options for climate change have positive impacts on mitigation. These include: 1) measures that reduce soil erosion; 2) measures that reduce leaching of nitrogen and phosphorus, 3) measures for conserving soil moisture, 4) increasing diversity of crop rotations by choices of species or varieties, 5) modification of microclimate to reduce temperature extremes and provide shelter, 6) land use change, involving abandonment or extensification of existing agricultural land or cultivation of new land. These adaptation measures will in general, if properly applied, reduce greenhouse gas emissions, by improving N use efficiencies and improving soil C storage.

There appears to be a large potential for synergies between mitigation and adaptation within agriculture. This needs to be incorporated into economic analyses of the mitigation costs. The inter-linkages between mitigation and adaptation are, however, not very well explored and further studies are warranted to better quantify short- and long-term effects on suitability for mitigation and adaptation to climate change. For realising the full potentials for agriculture in a climate change context there is a need to develop new agricultural production systems that integrate bioenergy and food and feed production systems. This may possibly be obtained with perennial crops having low environmental impacts and deliver feedstocks for biorefineries for production of biofuels, biomaterials and feed for livestock.

Soil carbon sequestration accounts for nearly 90% of the global mitigation potential in agriculture. Soil C sequestration works by increasing inputs of C to the soil (some of which remains locked up in longer term pools), or reducing losses of C from the soil, through reduced soil disturbance or rewetting of drained peatlands used for agriculture. Soil C increases are hard to measure and verify due to relatively small changes againts a large background C content. There are a number of well rehearsed arguments against reliance on carbon sequestration for tackling climate change, involving saturation of the carbon sink (the carbon is only removed from the atmosphere while the tree is growing or until the soil reaches a new equilibrium soil carbon level), permanence (carbon sinks can be reversed at any stage by deforestation or poor soil management), leakage/displacement (e.g. planting trees in one area leads to deforestation in another), verification issues (can the sinks be measured?, and total effectiveness relative to emission reduction targets (only a fraction of the reduction can be achieved through sinks)". Nevertheless, the mitigation potential is large and cost effective.

The Copenhagen Accords failed to include agriculture and failed to set quantified, binding, time-bound emission reduction targets. The disadvantages of leaving out agriculture from any climate deal include: a) leaving the potential for perverse incentives in the agricultural sector, b) it bars agriculture from easy access to carbon / GHG trading mechanisms – a market potentially worth 420, 130 or 32 Billion USD yr^{-1} for C prices of 100, 50 and 20 USD t CO_2-eq.$^{-1}$, respectively, c) it misses a significant "wedge" of the global mitigation potential – this makes global emission reduction targets less achievable. Developing country options for action / investment in GHG mitigation in agriculture include: a) for low cost / cost negative options – education, demonstration, policy, incentives, for low / medium cost options – policy, regulation and incentives, and c) for high cost options – research and development to bring down the costs and possibly some regulation. These options should be explored in greater detail.

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