Agriculture, forestry climate change and offsets

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Thank you for inviting me to address the subcommittee on climate change related issues. I have worked in teams addressing climate change effects, adaptation and emissions limitation for nearly 25 years. This could not have been possible without the US Government funding support that I have received. This arose particularly from EPA but also from USDA, DOE, NOAA and the Congress. I am grateful for the support.

Now let me touch on a few points that have arisen from that work focusing primarily on agriculture and forestry.

1 Climate change vulnerability

Agriculture, broadly defined to include forests and fisheries, is highly vulnerable to climate change related developments. Specifically agriculture is vulnerable in three fundamental ways.

- **Productivity effects of shifts in climate** will impact the sector though changes in temperature, precipitation, and extreme climatic events along with other climate attributes. Atmospheric carbon dioxide also will have implications. Here is just a sampling of some findings: work has shown crop yields worsened in the south and southwest but bettered in the north, pest populations and costs increased, yield variability increasing, range carrying capacity diminished, livestock appetite altered, subtropical developing agriculture negatively affected, tree growth altered and technical progress slowed (Reilly et al, Chen and McCarl, Paustian et al, McCarl et al, Irland et al).
- **Need to adapt to an altered climate and a carbon dioxide enriched atmosphere** will affect the sector. Climate change adaptation will involve alterations in crop and livestock mixes along with land management practices. It will also require added investment capital for facilities, altered production practices, research and extension (McCarl, 2007). Furthermore such actions today appear to be inevitable (Rose and McCarl).
- **Diversion of resources to limit the extent of climate change plus effects of higher energy prices**. Agriculture may face altered energy costs and face pressures/opportunities to limit emissions, produce substitute, lower emitting products (bioenergy) and enhance sequestration (Murray et al).

Collectively these forces mean agriculture will be substantially affected.

2 Limiting Climate change

Now let me turn to the topic of the day and that is agriculture's role in limiting the future magnitude of climate change by participating in an offsets market.

2.1 Opportunities

As argued by Dr. Murray there are a number of ways agriculture might participate in or be affected by a cap and trade market including

- agriculture generates about 6% of fossil fuel related emissions and would face increased fuel costs and needs to reduce usage (EPA)
- agriculture provides the bulk of the feedstocks for renewable and, in many cases, emissions reducing forms of energy (McCarl, 2008).
- Agriculture may be able to reduce a number of other emissions including those from livestock and manure, and fertilizer (McCarl and Schneider, 2001)
- Agriculture may be able to increase the rate of sequestration by changing tillage, afforesting, forest management, grassland conversion and others (Murray et al)
- Agriculture may be able to preserve existing carbon stocks by avoiding land use change and deforestation as discussed by Dr. Sohngen.

2.2 Attractive alternatives?

There are a number of reasons why the above opportunities may be attractive meriting current attention including

- The practices needed to implement the offsets, fossil fuel emissions reductions and renewable fuel feedstocks are generally **known, existing technology** (excepting cellulosic liquid fuels) not needing extended time until deployment (as is the case with for example carbon capture and storage) – Marland et al.
- Many of the technologies are currently implementable with low capital costs bridging us to a future with a decarbonized energy
- The use of agricultural activities has been shown in modeling studies to lead to substantial reductions in the domestic and international costs of limiting atmospheric greenhouse gas content (de la Chesnaye, and Weyant).
- The agricultural contribution can be large. For example, when we were analyzing possible Kyoto Protocol participation 10 years ago we found at higher prices that agriculture and forestry could offset the entire US obligation which was about 6% below 1990 levels plus 24% projected growth by 2012 or a total of 30% below today's levels.
- There are a number of large potential or readily exploitable alternatives including bioelectricity, liquid fuels from cellulose and wastes, feedstocks, afforestation, manure lagoon management, agricultural soils, forest management, and avoided deforestation (Murray et al).

2.3 Implementation Complexity

As Dr. Murray argued there are a number of complex implementation issues including the points he highlighted and more (additionality, uncertainty, permanence, saturation, leakage, transactions costs, measurement/monitoring, climate change interactions and aggregation/brokerage – Smith et al, Morgan et al). Some alternatives will turn out to be impractical in the face of these considerations. Today it is difficult to pick winners and losers. I feel it is desirable in setting up cap and trade to allow broad participation and establish a careful way of setting the cap then let the private market evolve to handle the complexity.

3 Cap and Trade Effects on Agriculture

Now let me turn attention to the implications that a cap and trade program would have on agriculture addressing the case both with and without the approval of offsets.

3.1 New markets

Fundamentally, the cap and trade program would provide agriculture with new markets and opportunities. If offsets are not broadly approved the market would likely be restricted to an increased demand for biofuel and bioelectricity feedstocks. If offsets are approved then agriculture could enter the carbon (broadly defined to encompass multiple greenhouse gasses) market selling the results of sequestration and emission reduction activities.

3.2 Competitive with existing markets

Producing offsets and bioenergy feedstocks on a large scale diverts agriculture from things it is now doing and ultimately is competitive with existing production. As such several things are expected.

- Market prices are likely to go up – with or without offsets (Schneider and McCarl, Murray et al, Baker et al). More with than without.
- Exports are likely to fall and world prices go up.

3.3 Producer Income and Consumer cost

The higher prices and added markets inevitably lead to higher agricultural incomes along with higher consumer and international food costs. This means reduced consumer and rest of world welfare with the losses therein being greater than the producer income gains. This would naturally have to be balanced off with the environmental benefits of cap and trade plus the savings in the rest of the economy of meeting the cap.

Furthermore, the agricultural income effects (Baker et al) are not uniformly distributed with crop producers gaining the most and livestock and forest somewhat less (although one can alter this by allocating afforestation incomes in different ways). There is also substantial gain in rural America from enhanced land based incomes plus distributed energy production under biofeedstock transformation to energy.

3.4 Environmentally complex

Collectively the use of offsets, fossil fuel use and bioenergy feedstock production generates a complex set of environmental impacts. Actions reducing tillage intensity, afforesting, converting grasslands etc lead to water quality and erosion benefits while higher market prices and increased land demand lead to more land development and intensification possibly increasing chemical use, erosion sequestration releases and water use. In addition, increases in agricultural participation in the cap allows less energy sector reduction and diminishes air quality gains that would occur with less fossil fuel usage (Elbakidze and McCarl). Finally, the international market consequences would stimulate production increase in other areas including the possibility of added deforestation.

4 Key role of technology

It merits mention that the pressures of an agriculture contributing to expanding demands for energy, limiting greenhouse gasses and food/fiber can only happen if technological progress remains high. Certainly technology investment is a complementary policy and is in fact a substantial way of limiting future greenhouse gas emissions (Schneider et al).

5 Summary

Agriculture will be affected by climate change and will need to adjust. It may be a big player in cap and trade if offsets are approved but would benefit from just increased energy prices in the absence of offsets. A complex market will need to evolve to handle agricultural offset characteristics and it appears desirable to allow wide participation.

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