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AGRICULTURE AND CLIMATE CHANGE MITIGATION

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Regardless of the projected or actual impacts of climate change, agriculture is also likely to be directly or indirectly involved in climate change mitigation efforts. Greenhouse gas emissions (GHGE) constitute a global production externality which is likely to adversely affect climate. The UNFCCC is trying to negotiate net GHGE emission reductions. Actions under that convention yielded the Kyoto Protocol which represents the first significant international agreement towards GHGE reduction. Agriculture (using a definition including forestry) is mentioned as both an emitter and a sink in the protocol. Annex A lists agriculture as an emission sources from enteric fermentation, manure management, rice cultivation, soil management, field burning, and deforestation. The protocol also lists agriculturally related sinks of afforestation and reforestation. Additional sources and sinks are under consideration including agricultural soil carbon.

Ways agriculture would be affected by climate change mitigation: Following the arguments in McCarl and Schneider (1999,2000a), there are at least four ways agriculture may participate in or be influenced by greenhouse gas mitigation efforts.

– Agriculture may need to reduce emissions because it releases substantial amounts of methane, nitrous oxide, and carbon dioxide.

– Agriculture may enhance its absorption of GHGE by creating or expanding sinks.

– Agriculture may provide products which substitute for GHGE intensive products displacing emissions.

– Agriculture may find itself operating in a world where commodity and input prices have been altered by GHGE related policies.

Each of these are discussed briefly in the following section

Agriculture - A source of greenhouse gases: The IPCC (1996) estimates that globally agriculture emits about 50% of total methane, 70% of nitrous oxide, and 20% of carbon dioxide. Sources of methane emissions include rice, ruminants and manure. Nitrous oxide emissions come from manure, legumes, and fertilizer use. Carbon dioxide emissions arise from fossil fuel usage, soil tillage, deforestation, biomass burning, and land degradation. Contributions across countries vary substantially, with the greatest differences between developing and developed countries. Deforestation and land degradation mainly occurs in developing countries. Agriculture in developed countries uses more energy, more intensive tillage systems, and more fertilizer, resulting in fossil-fuel based emissions, reductions in soil carbon, and emissions of nitrous oxides. In addition, animal herds emit high methane from ruminants and manure.

Agriculture - A sink for greenhouse gases : The Kyoto Protocol allows credits for emission sinks through afforestation and reforestation. Provisions allow for consideration of additional sources and sinks. Agriculture can serve as an emission sink in mainly offsetting CO_2 emissions. Management practices can increase soil carbon retention (commonly called carbon sequestration). Such practices include land retirement (conversion to native vegetation), residue management, less-intensive tillage, land use conversion to pasture or forest, and restoration of degraded soils. While each of these can increase the carbon-holding potential of the soil, some issues are worth noting. Soils can only increase carbon sequestration up to a point. Retained carbon increases until it reaches a new equilibrium state that reflects the new management environment. As the soil carbon level increases, soil absorption of carbon decreases and soil potential to become a future emission source since subsequent alteration of the management regime can lead to carbon releases. Third, enhanced carbon management can reduce agricultural productivity.

Agriculture - A way of offsetting net greenhouse gas emissions: Agriculture may provide substitute products which replace fossil fuel intensive products. One such product is biomass for fuel usage or production. Biomass can directly be used in fueling electrical power plants or maybe processed into liquid fuels. Burning biomass reduces net CO_2 emissions because the photosynthetic process of biomass growth removes about 95 per cent of CO_2 emitted when burning the biomass. Fossil fuel use, on the other hand, releases 100 per cent of the contained CO_2. Substitute building products can be drawn from forestry reducing fossil fuel intensive use of steel and concrete. Cotton and other fibers also substitute for

Contd.... p. 79