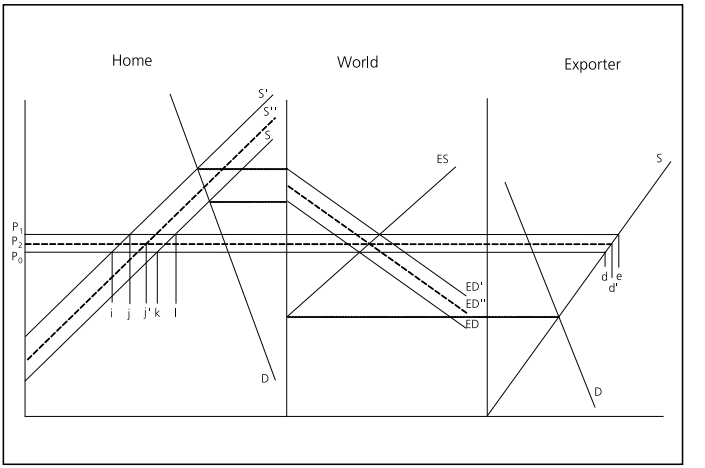
tariffs against non-complying country exports due to demand-side leakage may therefore be counterproductive. Point *j'* can easily be to the right of point *k* in Figure 10.7, rendering domestic leakage to be higher than the initial shift in the supply curve to S' (i.e., *ij'* can easily be higher than the distance *ik*). Hence, it is important to include the link between demand-side leakage and supply-side leakage.

FIGURE 10.7
Effects of demand-side leakage on supply-side leakage



But carbon tariffs or domestic production subsidies will have home country market prices go up even further, increasing domestic leakage while reducing international leakage, likely to negative levels. Although the initial cap and trade regime shifts the supply curve up to S' and reduces the carbon intensity per unit output, gross output increases with leakages, resulting in far lower reductions in emissions than originally intended, and with carbon tariffs or producer rebates, can easily increase total emissions.

It also can be shown that a carbon tariff results in lower GHG emissions than a per unit production subsidy of equal value. Home and exporter production with a tariff is point *j'* and *d',* respectively, in Figure 10.6, while a production subsidy will result in higher levels of production in each case (point *k* and *d* in the home and exporting country, respectively).

Summary

"Leakage" is traditionally defined as the increase in emissions due to GHG emission

mitigation policies (e.g., cap and trade or REDD) outside the economy being regulated. These policies generate changes in market prices, trade and location of production, thereby increasing emissions in unregulated economies. Leakage has to be distinguished from "shuffling" (where neither the location nor costs of production change but the environmental policy is nevertheless ineffective) and from "technical" leakage (differences in emissions intensity between regulated and unregulated economies magnify or dampen our definition of market leakage above).

The literature only recognizes "international" leakage. We show however, that emission mitigation policies in the agro-forestry sectors may have "domestic" leakages as well, in some cases outweighing international leakage. This means carbon tariffs can be counterproductive and increase total leakage. Carbon tariffs should also be adjusted downwards for both agricultural subsidies in cap and trade economies and for the reduced international leakage due to the correction of multiple market failures with an effective carbon offset program. Carbon tariffs can also cause international shuffling where products exported to cap and trade economies use low carbon inputs while other products not exported use high carbon inputs. Furthermore, there are interaction effects between supply-side leakages and demand-side leakages (the latter in the fossil fuel market) that need to be considered. Hence, further research is required to determine how to handle leakage with carbon offsets and with carbon tariffs for countries with cap and trade.

The analysis in this section should ideally be integrated with discussion of marginal abatement curves in Section 3 earlier. Carbon offset programs that subsidize abatement activities will shift the MNPB curve in developing countries, thereby affecting international prices. This affects optimal emission allowances and prices, thereby affecting the analysis in this section on leakage.

Inferring from the analysis above in Figures 5, 6 and 7, economic conditions are such that leakage appears to be higher for permits in rich country agriculture subject to the cap and trade relative to offsets purchased in developing country agriculture, using stylized facts about developing country agriculture compared to OECD agriculture. Furthermore, more research must be undertaken to determine whether the current rules are such that leakage in the CDM must account for shuffling and for both domestic and international leakage due to increased production in both other non-complying developing countries and OECD countries party to the climate agreement.

Domestic leakage is particularly important with agriculture not only because it is uncapped but because much of the emissions are not from reducing fossil fuel consumption directly but from agricultural production process, when can be reduced through changed production practices. Under a cap and trade regime,

the supply curve for agricultural products will shift up due to the increases costs of fossil fuels. For a fixed commodity price, this will induce a reduction in all inputs but less so for non-fossil fuel inputs like land. Once commodity prices increase due to the reduced supply, domestic leakage occurs with an increase in fossil fuel use and land (but more land per unit output now). Land conversion generates emissions. If agriculture is a large sector in the economy, permit prices will increase and land converted to agriculture accelerates even further.

10.4 The economics of targeted abatement subsidies

The analysis so far indicates that there is more leakage under cap and trade compared to carbon offsets in developing country agriculture. This is because carbon offsets are a subsidy for changes in production practices where most of the carbon emission mitigation potential exists in developing agriculture. The technical potential for mitigating GHG emissions from agricultural production varies among commodities, countries, and farm types. Total output may increase with enhanced productivity but emissions per unit output would fall, including from fossil fuel. The potential also exists for multiple co-benefits with altered production practices and so abatement subsidies can become a key component for productivity improvement and hence for poverty reduction and sustainable development.

Carbon offsets reduce emissions through the carrot of financial subsidies rather than the stick of emission limitations as with cap and trade. Bushnell, Peterman and Wolfram (2008) carefully show that targeted subsidies (subsidies for clean technologies etc.) minimize leakages and shuffling, unlike with a tax on emissions like cap and trade. The reason is that leakage stems from cost increases (supply-side leakages) or changes in consumption prices (demand-side leakages). For example, Key and Tallard (2009) find that two-thirds of the emissions reductions in a cap and trade scheme for livestock methane emissions are negated by leakages in non-complying countries. This emphasizes the potential of abatement activities in developing countries to minimize these leakages.

Instead of imposing costs on firms (or on consumption at the point of purchase), subsidies designed to reward production from non-emitting sources like subsidies for energy efficiency (subsidize clean behavior or technologies) are more effective. Indeed, subsidies may be the only way to go. Promotion of clean technologies can be more effective than limiting the use of dirty technologies. Targeted subsidies therefore are less vulnerable to leakage and shuffling because they do not impose costs on firms and so firms have no incentive to relocate production or avoid costs; in fact they have the opposite effects. Carbon offsets provide such a mechanism for targeted subsidies. However, the current method in the CDM with project-based carbon offsets presents a problem of monitoring, reporting and verification,

requiring complementary approaches (discussed later).

Imposing costs on consumers at the point of purchase induces shuffling. Bushnell, Peterman and Wolfram (2008) explain how a consumption based cap and trade can also fall victim to the reshuffling of production, just like an emissions tax levied on consumers and not on producers. Bushnell, Peterman and Wolfram (2008) give examples where targeted subsidies to technologies and clean production are generally immune (less vulnerable) to leakages and shuffling (e.g., subsidies to install solar energy facilities). This theory is very relevant to harness developing country agriculture's ability or potential to mitigate GHG emissions, and minimize leakages and shuffling.

The implications of the Bushnell, Peterman and Wolfram (2008) analysis is that the only way to meaningfully impact emissions on *a local level or for non-complying countries* is with targeted subsidies like emission abatement subsidies. The carrot (rather than the stick) will also induce co-benefits and learning by doing etc. In addition, there will be political opposition in developing country agriculture to use policies that induce higher production costs (most poverty is in rural areas plus there will be fears of losing international competitiveness). Abatement subsidies therefore avoid situations directed at increasing costs of production or reducing consumption. Instead, policies that employ targeted subsidies for altering inputs and technologies towards 'clean' technologies will be more effective and politically acceptable.

Carbon offsets based on projects often do share problems with incentive-based schemes like cap and trade in terms of transactions costs of measuring and monitoring emissions, verifying compliance and administrating and enforcing policy. Polluter pay principle is in theory the accepted methodology (OECD 2005). But this is not relevant for developing county agriculture because of transactions cost in implementing penalties or taxes (monitoring, verification etc – like non-point pollution issues in developed countries – therefore, other institutional arrangements are needed). There is also the issue of equity – smallholder agriculture has low incomes and penalties will not work unless an alternative income strategy is implemented. It is therefore best to combine environmental policy with income generation policy. Here is where there are potential synergies between emission mitigation efforts and improving rural incomes and sustainable development.

Alternative methods of financing and implementing abatement subsidies

Project-based carbon offsets have the disadvantage of transactions costs of implementation. This requires a modified CDM for carbon offsets and additional complementary institutional arrangements to finance abatement activities for developing country agriculture. CDM reform options include the move from a project by project to a wholesale approach or to complement rather than replace the project-by-project approach. The three main CDM scaling up options include

bundling, "program of activities" and geographic regions based programs. A range of alternatives to broaden participation by developing countries have been proposed including a "programmatic" CDM (through aggregation of individual projects into a "program of activities"), a "sectoral" CDM (with either a multi-project baseline for the sector or a national baseline), and a "policy" CDM (UNFCC 2008a; Burniaux et al. 2009; Schneider and Cames 2009; Baron and Ellis 2006; Baron, Buchner and Ellis 2009; Ellis and Kamel 2007).

Variations of the sectoral approach include a "sectoral no-lose target' and binding sectoral targets under which some developing countries could cap their emission levels or emission intensity. The latter has the advantage of reducing mitigation cost uncertainty (Burniaux et al. 2009) and of minimizing leakage (Holland 2009)[39].

A policy CDM is an option where specific government policies would deliver CERs. Eligible policies would be sectoral. These options would decrease transactions cost, but would not necessarily solve the problems of additionality, leakage and perverse incentives. Because of specific difficulties in dealing with REDD, experts recommend that REDD be implemented at a national rather than project based level. The same can be said for all emissions associated with agriculture and LULUCF. The FAO (2008) also calls for the funding of "Nationally Appropriate Mitigation Actions" - NAMAS (that account for differences in local conditions and that would be complementary to the CDM), the implementation of sustainable development policies and measures (SD-PAMs), and actions that link mitigation and adaptation.

Another option under discussion is to replace the CDM with a Fund to finance emissions reductions in developing countries (Burniaux et al. 2009; UNFCC 2008a). Such a policy would have the advantage of sheltering permit prices and giving direct control to parties the Kyoto over the amount of emissions abated, while allowing for the purchase of credits at different prices, depending on marginal abatement costs. This could increase developing country participation. Direct funding of mitigation efforts is also an option through the scaling up of Multilateral Funds or of bilateral initiatives. Efforts are also needed to encourage international transfers and deployment of climate related technologies and for developing countries remove policy distortions like barriers to trade and foreign direct investment, and the absence of or lack of enforcement of intellectual property rights. International cooperation is also likely easier to achieve in R&D than in mitigation efforts (Burniaux et al. 2009).

Wara and Victor (2008) and Ackerman (2008) are more skeptical of the CDM reflecting actual reductions in emissions and so argue for two additional elements: a Climate fund intended to finance critical changes in developing country policies;

[39]It is possible that intensity targets like California's low carbon fuel standard can increase GHG emissions (de Gorter 2009).

and infrastructure deals with the aim of shifting the longer term development trajectories that produce large reductions in GHG emissions. These two options would also be compatible with the argument in this paper for public subsidies of abatement activities for developing country agriculture.

Institutional considerations and capacity building

The bottleneck facing developing country agriculture's participation in GHG emissions mitigation is not always simply money. Efforts are also required to change institutions; there are not only infrastructural and technological barriers but also institutional barriers. Forest carbon sequestration projects face many formidable obstacles due, in part, to substantial transaction costs, large risk and uncertainties, long time horizons and high establishment costs. Gong, Bull and Baylis (2009) illustrate how social capital, property rights and contractual rules impact the local land users' willingness to participate. Uncertainties arise from ambiguous property rights, vague or rapidly changing government policies and unknown carbon market prices. Additionally, there is underlying risk from human-induced and natural disasters. The paper is a good example of how these three aspects affect the optimal design and implementation of a project, where they must not only provide sufficient financial incentives to land-users, but also need to incorporate the complex institutions in which they operate.

The FAO (2008) highlight four aspects of an enabling institutional and policy environment required to realize potential of emission mitigation for developing country agriculture (facilitate aggregation of carbon crediting; policies in agricultural, financial and environmental sectors that facilitate the flow of low carbon finance from private and public sectors; capacity building; and an agreed system of property rights to the carbon benefits that can be generated).

Implications for WTO rules

Issues surrounding WTO law and developing country agriculture with cap and trade and carbon offsets fall into broad two categories:

1. Because carbon offsets subsidize the reduction of GHG emissions in developing countries and runs contrary to the polluter pay principle developed by the OECD (2005), the CDM and this paper's call for more funding (with revenues from an expanded CDM beyond projects-only and complementary funds from other sources including the General Environmental Fund and traditional aid programs) seemingly violates subsidy rules under the WTO, namely the Agreement on Subsidies and Countervailing Measures (SCM) and the green box criteria under the Agreement on Agriculture
2. Import tax (export subsidy) adjustments for the effect of a cap and trade regime in taxing (increasing costs) to domestic producers is allowed under the WTO but with several provisos

The first category above deals with the validity of developing country policies while the second affects developing country export and import competing industries.

This paper argues abatement subsidies are superior for several reasons; not least because of the administrative and political infeasibility of levying taxes on developing country agriculture to reduce GHG emissions. Abatement subsidies correct two other distinct market failures, namely the public good nature of reducing emissions by altering production practices and technologies (rather than reducing fossil fuel consumption) and the public good nature of the innovation and diffusion of the requisite practices and technologies. Several co-benefits result. But there is a risk that such subsidies will be used to favor domestic production at the expense of imports (or competing exporters).

Governmental financing for the development and deployment of low-carbon goods and technologies may have an impact on the price and production of such goods. This leads to lower producer costs, leading to lower product prices. In turn, lower prices may reduce exporting countries' access to the market of the subsidizing country, or may result in increased exports from the subsidizing country. WTO rules are intended to constrain members' ability to adopt such protectionist subsidies while at the same time allow scope for legitimate subsidies (Tamiotti et al. 2009). There are various WTO rules on subsidies (including the now expired limited exception for environmental subsidies), impacting the ability to implement abatement subsidies.

Green (2006) identifies some potential reforms to the WTO rules that would permit policies that are more effective at addressing climate change while at the same time eliminating discriminatory policies. Tests for determining permissible subsidies are unlikely to be effective, so a broadened exception for environmental subsidies similar to Article XX of GATT, while not optimal, would be an improvement over the current rules.

Detailed rules on border tax adjustments (BTAs) exist in the General Agreement on Tariffs and Trade (GATT) and the WTO's SCM Agreement. These rules permit, under certain conditions, the use of BTAs on imported and exported products. The objective of a border tax adjustment is to level the playing field between taxed domestic industries and untaxed foreign competition by ensuring that internal taxes on products are trade neutral (Tamiotti et al. 2009). In the context of climate change, the debate has mainly focused on two aspects: the extent to which domestic carbon/energy taxes (which are imposed on inputs, such as energy) are eligible for border tax adjustments; and the extent to which BTAs may be limited to inputs which are physically incorporated into the final products.

The general approach under WTO rules has been to acknowledge that some degree of trade restriction may be necessary to achieve climate change goals,

provided core principles of the GATT are respected (must not constitute a "means of arbitrary or unjustifiable discrimination" or a "disguised restriction on international trade"). If the BTA was found to be inconsistent with one of the core provisions of the GATT, justification might nonetheless be sought under the general exceptions for the environment to the GATT under Article XX.

10.5 Concluding remarks

It is well documented that developing country agriculture has a huge potential to reduce GHG emissions, mostly by altering production practices (not by reducing fossil fuel use directly). The sources of agriculture's reduction opportunities are many but mostly centre on altering production methods and technologies for soil carbon sequestration practices, midseason drying of irrigated rice, nutrient management to reduce nitrous oxide emissions, and management of livestock systems to reduce methane emissions. Because of the multifunctional nature of agricultural production, policies that mitigate GHG emissions can also correct for the market failures due to "technical" externalities of production (both positive and negative). In addition, there is a market failure in the innovation and diffusion of abatement technologies and production practices itself, requiring public expenditures in R&D and extension services. Correcting for these multiple market failures can be achieved most effectively through public subsidies of emission abatement activities, not with environmental taxes.

The efficacy of subsidized abatement activities are enhanced by several other considerations as well. For example, we show how targeted subsidies for abatement are less vulnerable to leakage and shuffling because they do not impose costs on firms, so firms have no incentive to relocate production or avoid costs, unlike with a tax on emissions. Carbon offsets provide such a mechanism for targeted subsidies, reducing emissions through the carrot of financial subsidies rather than the stick of emission limitations or environmental taxes.

In addition, public subsidies for abatement activities also help overcome the administrative infeasibility of employing emission taxes in developing country agriculture, reinforcing other rationales identified above for targeted subsidies of abatement activities. Meanwhile, these abatement subsidies have the potential to increase agricultural productivity, generating pecuniary externalities in the form of enhanced food security, poverty reduction and economic development.

However, agriculture's participation in the project-based CDM is also plagued with administrative infeasibility due to transactions costs related to implementation, monitoring and verification of emission reductions. As a result, agriculture has seen very limited use under the CDM. This requires a modified CDM for carbon offsets and additional financing mechanisms and institutional arrangements to finance

abatement activities for developing country agriculture. Proposals have ranged from a scaled-up CDM (bundling, "program of activities" and geographic regions based programs) to a sectoral approach (sectoral crediting mechanisms and sectoral targets) to complementary public sector climate initiatives like a Climate Fund or the funding of "Nationally Appropriate Mitigation Actions". CDM reform options also include the move from a project by project to a wholesale approach like a "policy" CDM where specific government policies would be funded.

Abatement subsidy programs also represents an opportunity to reform domestic agricultural policy in developing countries where funds now used to subsidize inputs, for example, can be reconfigured to subsidize abatement activities. Reductions in developed country agricultural subsidies are also required to improve efficacy of GHG mitigation efforts in developing countries. Abatement subsidies should not run afoul of WTO law regarding subsidies, just as carbon offsets currently do not. In many cases, agricultural output will increase, reducing international prices and so reducing GHG emissions elsewhere as well (a positive leakage).

Because deforestation in developing countries is the largest source of emissions, caused primarily by land conversion to agriculture, activities in land use, land use change and forestry (LULUCF), reducing emissions in agriculture is interdependent with avoided deforestation and land degradation (REDD), afforestation and reforestation (A/R), forest management (FM) and biofuel production (which avoids emissions from fossil fuel consumption). Mitigation policies should be coordinated across all of these areas simultaneously, and because of the specific difficulties in dealing with these, be implemented at a national level.

The results in this paper show that carbon offsets benefit both the cap and trade economy and developing countries. Offsets also provide an incentive for regulated economies to further increase their emission reduction targets. Limits on carbon offsets (as is currently the case and proposed in U.S. legislation), however, hurt cap and trade economies while having an ambiguous impact on developing countries.

The paper also addresses the implications of distinguishing international from domestic leakages and from "shuffling" and "technical" leakage (differences in emissions intensities between countries). Domestic leakages in some cases can outweigh international leakage such that carbon tariffs can increase total leakage. The issue of leakage is shown to be important because it affects developing countries in both directions: the ability to sell offsets and the restrictions imposed on exports to countries with cap and trade regimes.

The conclusions of this paper are consistent with the Stern Review (2007) which emphasized complementary, non-market policies to create and adopt low-carbon technologies, leading to a new, green path to development. In addition to the market based carbon offset program under the CDM, public incentives, financial

resources and investments for developing country agriculture to mitigate GHG emissions are needed to promote sustainable agricultural production practices and technologies.

References

Ackerman, F. (2008). "Carbon Markets and Beyond: The Limited Role of Prices and Taxes in Climate and Development Policy." G-24 Discussion Paper No. 53 UNCTAD/GDS/MDP/G24/2008/4

Baron, R., and J. Ellis. (2006). "Sectoral crediting mechanisms for GHG mitigation: institutional and operational issues." IEA/OECD, COM/ENV/EPOC/IEA/SLT(2006)4, Paris, France.

Baron, R., B. Buchner and J. Ellis. (2009). "Sectoral Approaches and the Carbon Market." OECD/IEA, COM/ENV/EPOC/IEA/SLT(2009)3, Paris, France.

Baumol, W.J. and W.E. Oates. 1988. *The Theory of Environmental Policy*, 2nd Edition. Cambridge: Cambridge University Press.

Boisvert, R.N. and H.H Chang. (2006). "Multifunctional Agricultural Policy, Reduced Domestic Support and Liberalized Trade: An Empirical Assessment for Taiwanese Rice." Comprehensive Assessment of Water Management in Agriculture, Research Report 14, International Water Management Institute, Sri Lanka.

Bovenberg, A.L., and L.H. Goulder. (2000). "Neutralizing the Adverse Industry Impacts of CO2 Abatement Policies: What Does it Cost?" NBER Working Paper No. 7654, April.

Burniaux, J.M., J. Chateau, R. Dellink, R. Duval and S. Jamet. (2009). "The Economics of Climate Change Mitigation: How to Build the Necessary Global Action in a Cost-effective Manner." Economics Working Papers No. 701, ECO/WKP(2009)42 26 June. OECD, Paris, France.

Bushnell, J., C. Peterman and C. Wolfram. (2008). "Local Solutions to Global Problems: Climate Change Policies and Regulatory Jurisdiction." *Review of Environmental Economics and Policy*, Volume 2, Issue 2, summer, pp. 175-193.

de Gorter, H. (2009). "Life-Cycle Accounting for Biofuels: Will California's Approach Work in Developing Countries?" Paper presented in conference Biofuels in the World Economy, Woodrow Wilson Center, Washington D.C., 24 July 2009.

de Gorter, H., D.R. Just and J.D. Kropp. (2008). "Cross-subsidization due to Infra-Marginal Support in Agriculture: A General Theory and Empirical Evidence." *American Journal of Agricultural Economics* 90(2) : 45 – 54

Ellerman, A.D. (2008). "New Entrant and Closure Provisions: How do they Distort?" *The Energy Journal*, pages 63-76.

Ellis, J., and S. Kamel. (2007). "Overcoming barriers to Clean Development Mechanism Projects." OECD and UNEP/RISOE, May.

Figueres, C. (2009). "Where do we stand with programmatic CDM?" Paper presented at expert meeting on trade and climate change, UNCTAD, April.

FAO. (2009a). "Proceedings of the Symposium on Mitigating Greenhouse Gas Emissions from Animal Production: A Policy Agenda." Asunción, Paraguay, 6-8 May.

_____(2009b). "Statement on Mitigation of Greenhouse Gas Emissions from Animal Production." Committee on Commodity Problems, Inter-governmental Group on Meat and Dairy Products, Twenty-second Session, CCP: ME 09/CRS.3 Asunción, Paraguay, 6-8 May.
http://www.fao.org/ag/againfo/home/en/news_archive/Proceedings_IGG09/statement_en.pdf

_____(2008). "Enabling Agriculture to Contribute to Climate Change Mitigation." Submission to UNFCC
http://unfccc.int/resource/docs/2008/smsn/igo/036.pdf

_____ (2007). *Paying Farmers for Environmental Services*. The State of Food and Agriculture. Rome, Italy.

Frankel, J. (2009). "Environmental Effects of International Trade." Harvard Kennedy School Working Paper RWP09-006, January.

Gerber, P., and H. Steinfeld. (2009). "Livestock sector's growth and its implications for climate change." In Proceedings of the Symposium on Mitigating Greenhouse Gas Emissions from Animal Production: A Policy Agenda." Asunción, Paraguay, 6-7 May.

Gong, Y., G. Bull and K. Baylis. (2009). "Participation in the First CDM Project: The role of property rights, social capital and contractual rules." Available at:
http://works.bepress.com/kathy_baylis/19

Goulder, L.H., M.A.C. Hafstead and M.S. Dworsky. (2009). "Impacts of Alternative Emissions Allowance Allocation Methods under a Federal Cap-and-Trade Program." NBER Working Paper No. 15293, 31 August.

Green, A. (2006). "Trade rules and climate change subsidies." *World Trade Review* 5:3, pp. 377-414.

Holland, S.P. (2009). "Taxes and Trading versus Intensity Standards: Second-Best Environmental Policies with Incomplete Regulation (Leakage) or Market Power" 19 August. Center for the Study of Energy Markets. Paper CSEMWP-190.

Jaffe, A.B., R.G. Newell and R.N. Stavins. (2005). "A Tale of two Market failures: Technology and Environmental Policy." *Ecological Economics*, 54:164-174.

Key, N., and G. Tallard. (2009). "Methane Emissions from Livestock: Policy Issues and Analysis." in Proceedings of the Symposium on Mitigating Greenhouse Gas Emissions from Animal Production: A Policy Agenda." Asunción, Paraguay, 6-7 May.

Mendelsohn, R., and A. Dinar. (2009). "Land Use and Climate Change Interactions." *Annual Review of Resource Economics*, Vol. 1: 309-332, October.

Muller, B. (2009). "Additionality in the Clean Development Mechanism: Why and What?" Oxford Institute for Economic Studies, March.

Murray, B.C. (2008). "Leakage from an avoided deforestation compensation policy: Concepts, empirical evidence, and corrective policy options." NI WP 08-02. Nicholas Institute for Environmental Policy Solutions, Duke University, Durham, North Carolina.

Murray, B.C., B.A. McCarl, and H. Lee. (2004). "Estimating Leakage from Forest Carbon Sequestration Programs." *Land Economics* 80(1):109–124.

Murray, B.C., R. Lubowski and B. Sohngen. (2009). "Including International Forest Carbon Incentives in Climate Policy: Understanding the Economics." Nicholas Institute for Environmental Policy Solutions, Duke University, Durham, North Carolina Working Paper NI R 09-03, June.

Nelson, G.C., R. Robertson, S. Msangi and T. Zhu. (2009 forthcoming). "India Greenhouse Gas Mitigation: Issues for Indian Agriculture." International Food Policy Research Institute Discussion Paper, July, Washington, D.C.

Nelson, G.C. (ed.). (2009). "Agriculture and Climate Change: An Agenda for Negotiation in Copenhagen." International Food Policy Research Institute 2020 Vision for Food, Agriculture and the Environment Focus 16, May. Washington, D.C.

OECD (Organization for Economic Cooperation and Development). (2001). "Multifunctionality: Towards an Analytical Framework." Paris, France.

_____. (2005). "Analytical Framework for Evaluating the Costs and Benefits of Extended Producer Responsibility Programmes." ENV/EPOC/WGWPR(2005)6/FINAL, Paris.

Parry, I.W.H. (2003). "Fiscal Interactions and the Case for Carbon Taxes over Grandfathered Carbon Permits." *Oxford Review of Economic Policy.* 19:385-99.

Peterson, J., R.N. Boisvert and H. de Gorter. (2002). "Environmental policies for a multifunctional agricultural sector in open economies." *European Review of Agricultural Economics* 29 (4):423-443.

Pearse, D., and K. Turner (1990). *Economics of Natural Resources and the Environment.* Baltimore: Johns Hopkins University Press.

Schamel, G., and H. de Gorter. (1996). "Analyzing Environmental Policy with Pollution Abatement versus Output Reduction: An Application to U.S. Agriculture." Working Paper 96-02, Dept. of Agricultural, Resource & Managerial Economics, Cornell University, (revised December 1996).

Schneider, L. (2007). "Is the CDM fulfilling its environmental and sustainable development objectives? An evaluation of the CDM and options for improvement." Report prepared for WWF Berlin, 5 November.

Schneider, L., and M. Cames. (2009). "A framework for a sectoral crediting mechanism in a post-20212 climate regime." Report for the Global Wind Energy Council, May.

Smith, P., D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes and O. Sirotenko. (2007). "Agriculture." In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Spulber, D.F. (1985). "Effluent Regulation and Long-run Optimality." *Journal of Environmental Economics and Management* 12: 103-116.

Stavins, R.N. (1997). "Policy Instruments for Climate Change: How Can National Governments Address a Global Problem?" Resources for the Future Working Paper RFF 97-11, January.

Stern, N. (2007). *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge.

Tamiotti, L., R. The, V. Kulaçoglu, A. Olhoff, B. Simmons and H. Abaza. (2009). "Trade and Climate Change." Report by the United Nations Environment Programme and the World Trade Organization. Geneva, Switzerland. http://www.wto.org/english/news_e/pres09_e/pr559_e.htm

UNFCCC Secretariat. (2008a). "Investment and financial flows to address climate change: an update." Technical paper, (FCCC/TP/2008/7).

UNFCCC Secretariat. (2008b). "Challenges and opportunities for mitigation in the agricultural sector." Technical paper (FCCC/TP/2008/8)

United Nations Conference on Trade and Development (UNCTAD). (2009a). "The State Play of Clean Development Mechanism: Review of Barriers and Potential Ways Forward." UNCTAD/DITC/BCC/2009/3, Geneva, Switzerland.

_____. (2009b). "Trade and investment opportunities and challenges under the Clean Development Mechanism (CDM)." TD/B/C.I/EM.1/2, April, Geneva.

Wara, M.W. and D.G. Victor. (2008). "A Realistic Policy on International Carbon Offsets." Working Paper No. 74, Program on Energy and Sustainable Development, Stanford University.

Wassmann, R., Y. Hosen, and K. Sumfleth. (2009). "Reducing Methane Emissions from Irrigated Rice." in Nelson (ed.) (2009) Agriculture and Climate Change: An Agenda for Negotiation in Copenhagen, Focus 16, Brief 3.

Wunder, S. (2009). "How do we deal with leakage?" In Angelsen, A. (ed). Moving Ahead with REDD: Issues, Options and Implications. CIFOR. Bogor, Indonesia.

Zomer, R.J., A. Trabucco, R. Coe and F. Place. (2009). "Trees on Farm: Analysis of Global Extent and Geographical Patterns of Agroforestry." ICRAF Working Paper no. 89. Nairobi, Kenya: World Agroforestry Centre.

The recent world food crisis highlighted the critical issue of global food security and the need to enhance global agricultural production capacity to meet current and future food demand. Increased investment in agriculture and adequate incentives to farmers are required to meet this global challenge. A key challenge is how to shape and design support to farmers in both the developed as well as the developing world while minimizing those distortions to global markets that are potentially harmful to developing countries, and at the same time promoting global food supply adequacy, food security for the undernourished, and poverty reducing and growth incentives for the farmers in low income food deficit countries.

Developed countries provide support to farmers to increase farm income, reduce income variability, improve competitiveness of the agricultural sector, and provide for safe and quality food. Many farm support policies stimulate domestic production, but also create distortions in world markets, inducing disincentives in developing countries' agricultural production in the long run. These distortions have been the object of considerable debate within the World Trade Organization agreement on agriculture.

In developing countries farm policies have been driven largely by the need to accelerate a transition from low income agrarian structures to more developed industrialized and service oriented economies. The overall effects of such policies, have been largely to tax producers. In the process, the agricultural sectors in many developing countries have faced negative policy biases, low growth rates, and high poverty incidence, while inducing increasing import dependence.

The book provides a review of farm support in high income countries, and explores options for reshaping such farm support in a non-distortionary manner. It also addresses the responses needed in developing countries to ensure a long term and sustained faster growth in their agricultural sectors, enhanced food production, rising rural incomes, and lower poverty. The book is divided into two parts. In part one, it focuses on developed country farm support policies and their implications for market distortions in third countries, with particular focus on decoupled support and the complementary policies needed to support developed country farmers without creating market distortions. Other issues examined are risk mitigation and insurance related schemes, trade and market access reform under the Doha round, and biofuel policies.

ISBN 978-92-5-106388-0

9 789251 063880

I1088E/1/10.08/1500