

# Agricultural Subsidies and Environmental Change

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*With or without subsidies, agriculture as a major land use has a profound effect on the environment; environmental degradation by farmers has been going on for millennia, but many farmers have learnt to look after the natural resources that they use and have responded quickly to economic incentives to do so as they seek ways to sustain their livelihoods. Agricultural activities impact on the environment via soil quality (texture, erodibility, nutrient depletion, moisture balances, salinity and soil conservation, including flood protection and landscape), water systems, including surface and groundwater pollution and irrigation, air quality, including greenhouse gas emissions, biodiversity, wildlife habitats and ecosystems. Environmental change is an inevitable by-product of agricultural activity; policy instruments like subsidies may, by modifying both producer and consumer behavior, increase or decrease the rate of environmental change. Population pressures on the natural resource base are also a further important source of environmental change, as an ever-expanding population attempts to satisfy its increasing demands for a wide variety of goods and services.*

*Conventional, neo-classical production economics theory suggests that input price subsidies/taxes and output price subsidies/taxes will promote intensification/extensification of production processes. Subsidies will increase the use of variable production inputs, such as fertilizer, irrigation water, pesticides and herbicides; they will change the optimal combination or factor proportions with which inputs are used, and output price subsidies will lead farmers to substitute one crop for another or change between crop production and livestock production processes. Associated with this changing farmer/land user behavior will be different patterns of environmental impacts having both local and wider implications; that is, the environmental impacts will be felt at local, river catchment, regional and global levels. Examples include non-point pollution effects of agricultural activity, water quality and sedimentation, and the global effects due to the carbon balances of agriculture. There is some ambiguity about the role of subsidies and environmental change; subsidies by changing price signals may lead farmers to substitute polluting inputs for non-polluting ones, or to change from production processes which give low emissions (e.g., cereals and sheep) to those giving high emissions (e.g., dairy cows).*

## AGRICULTURAL SUBSIDIES

The environmental effects of economic support and subsidies to agriculture have recently attracted considerable

scientific and political interest. Agricultural subsidies can take many forms, but a common feature is an economic transfer, often in direct cash form, from governments to farmers. These transfers may aim to reduce the costs of production in the form of an input subsidy, e.g., for inorganic fertilizers or pesticides, or to make up the difference between the actual market price for farm output and a higher *guaranteed price*. Subsidies shield sectors or products from international competition. The stated governmental aims of agricultural policy worldwide are many, but essentially involve farm income support and price stabilization. However, by artificially reducing the costs of production or providing taxpayers' money for an output that nobody really wants (at least at such high prices), agricultural subsidies encourage wasteful use of materials, energy and natural resources and also encourage over-production.

Analysis of the environmental and economic impacts of agricultural subsidies is exceedingly complex, but many are unquestionably damaging, for example, the practice in forested tropical countries of providing cash incentives for clearing forest land for agriculture and livestock production. Similarly, subsidies to irrigation water, in the form of less than full-cost recovery pricing, encourage over-use of scarce water, and hence, water logging and soil salinization. In contrast, a subsidy to promote and encourage kerosene consumption may be environmentally beneficial if it reduces the demand for fuel wood and deforestation. Deciding which subsidies are, or are not, environmentally benign is extremely hazardous. Boldly stated, agricultural subsidies can encourage the production of environmentally harmful pollution, lead to the excessive use of natural resources and often impose high costs on consumers, taxpayers and government budgets. Their reduction/removal would increase economic efficiency, reduce government spending and, at the same time, improve environmental quality. Farm incomes and profitability will eventually recover following an initial adjustment period.

The exclusion of environmental externalities (e.g., pollution) from the profit and loss accounts of farmers and land users means that environmental damage caused by their economic activities is not paid for by those directly responsible for causing the externality. Private costs differ from *social costs*, and society and the environment must pick up the bill. This is often aggravated by government agricultural support or subsidy programs, which artificially raise the price of agricultural output and further encourage agricultural production and the associated, unpriced environmentally harmful by-products. Support removal, along with complementary policies to internalize social and environmental externalities, will lead to society *getting the prices right* and optimizing the economic system.

There is, however, no precise, easily disentangled, quantitative link between the size and type of agricultural support and the environmental damage caused. The linkages

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between support and the environment are complex and often indirect and depend upon:

1. agricultural input and output markets, competition within them, and particularly, the price elasticities or responses to price changes;
2. the availability of substitute technologies;
3. taxation regimes and institutional and regulatory frameworks;
4. the biophysical characteristics of the recipient environment, particularly its assimilative capacity. Farming practice effects on the environment will be dependent on site-specific, agri-environmental conditions.

This makes a general environmental assessment of the benefits of agricultural subsidy removal extremely difficult.

### MEASURING AGRICULTURAL SUBSIDIES

There are a wide variety of government agricultural support policies and programs worldwide, and the measurement of subsidies is difficult. General Agreement on Tariffs and Trade (GATT) talks and World Trade Organization (WTO) discussions require quantification of agricultural protection by various countries in order to reduce complicated agricultural trade negotiations to measurable dimensions. A benchmark or baseline from which subsidies can be measured is required, and economists often use world prices as this benchmark; that is the price that could be obtained if a product or resource was sold internationally. This is based upon the concept of opportunity cost to the nation. For example, if wheat sells for \$150 per tonne on the world market and the European Union (EU) pays its farmers \$200 per tonne, EU farmers are effectively being subsidized by \$50 per tonne. Likewise, if fuel oil sells for \$10 per barrel in a country but, if exported, could secure \$15 per barrel, then the domestic market is being subsidized by \$5 per barrel.

*Producer subsidy equivalents* (PSEs) are a widely accepted measure of the extent of agricultural subsidization (Cahill and Legg, 1989). PSEs measure the overall level of support to producers of a given commodity. Expressed as a percentage, they represent that part of the value of output accounted for by various kinds of market price support, direct income support, indirect income support and other support. If  $P_W$  is the unassisted price frequently determined by reference to the world market price, the price at which food imports are available at the border, then PSEs measure the gap between this price and the domestic price that the policy causes. For domestic price,  $P_D$ , output,  $Q$ , direct income support,  $D$ , levies,  $L$ , and combined indirect income support and other support,  $B$ , the PSE is defined as:

$$\text{Total PSE} = Q(P_D - P_W) + D - L + B \quad (1)$$

$$\text{Per Unit PSE} = \frac{\text{Total PSE}}{Q} \quad (2)$$

The total PSE is thus the net addition to the value of a commodity above the unassisted world price. The level of a country's PSE normally changes whenever the world price, in terms of that country's currency, changes: that is, it is sensitive to foreign exchange rate changes. In most developed countries, PSEs are positive, i.e., farmers are subsidized (and consumers are taxed); the higher the percentage PSE, the higher the per unit subsidy. However, in many developing countries and economies in transition, the opposite is the case and the PSEs are negative; i.e., farmers are taxed and consumers are subsidized – a cheap food policy. A negative PSE is interpreted as taxation of farmers rather than subsidization or protection. Within the WTO talks, PSE measurement assumes a critical place. A reduction in PSE-type support is the objective and reductions in PSEs are used to monitor the progress of trade reform. Table 1 presents some calculated PSEs showing the extent of agricultural subsidization across a variety of countries.

Few developed countries choose not to subsidize agriculture, although, not surprisingly, New Zealand and Australia, as countries relying to a large extent on agricultural exports, come closest to this. New Zealand completely dismantled its agricultural subsidies over the period 1984–1987; following the removal of subsidies, sheep numbers, fertilizer use and pesticide use declined and there was an increase in afforestation. Land prices initially fell by 60% and fertilizer use declined by 50%. However, they soon recovered, and by 1995, land prices were back to 80% of their 1982 values in real terms. Land clearing and overstocking, which had led to widespread soil erosion, were much reduced and the number of full-time farm workers actually increased. Livestock production, formerly encouraged by subsidies, which had encroached onto erodible hillsides, is now being intensively practiced on better pasture land, and the hills are being replanted with trees. In 1995, agriculture and related industries accounted for 15% of New Zealand's gross domestic product (GDP) and agricultural products for 50% of New Zealand's exports. The EU and Japan still highly subsidize their farmers by paying them prices well above the

**Table 1** PSEs by country (1997)<sup>a</sup>

	PSE (%)
New Zealand	3
Australia	9
US	16
Hungary	16
Canada	20
Poland	22
Russia	26
EU	42
Japan	69
Norway	71

<sup>a</sup> Source: OECD Secretariat Website, 1998: <http://www.oecd.org>.

comparable international trade prices; rice prices in Japan are some 8–10 times greater than world prices, and EU butter prices are much higher than those in New Zealand which largely determines the world price. The inflated price paid to Japanese rice farmers encourages them to safeguard their crops against any small risk of decreased yield. As a consequence, in 1993, the total rice insecticides market was \$1.1 billion, of which 34% was spent in Japan, although Japan produces less than 3% of the world's rice. Subsidizing pesticide prices in Indonesia in the 1980s led to a large and unnecessary use of insecticides; when the subsidy was withdrawn and insecticide use was replaced by integrated pest management (IPM), rice yields continued to increase (Greenland, 1997). Inflated domestic prices can only be maintained by strict controls on international trade – import tariffs and levies, quotas and non-tariff barriers; exports can only be sustained by facilitating export subsidies.

The calculated PSEs for other countries are less readily available, but for many African nations and central and eastern European economies in transition, they are probably negative. This means that farmers in these countries are, in effect, being taxed, not subsidized. Ivanova and Lingard (1994) calculated large negative percentage PSEs for a wide range of agricultural commodities in Bulgaria in the mid-1990s. This taxation results in low levels of profitability in Bulgarian agriculture, few incentives to use production inputs other than family labor, unsustainable soil nutrient management practices, obsolete non-functioning irrigation systems and a declining capital base for the production of vineyards, orchards and livestock breeding herds. A profitable agriculture would draw more resources to the sector, thereby ensuring that fewer resources are employed in less productive and more polluting industrial production. Within Africa, marginal land is often used for subsistence food production by squatting, poverty-stricken, landless laborers unable to find paid work. An increase in agricultural product prices to their comparable trade parity prices would increase employment on commercial farms and increase wages and incomes in rural areas. The taxation of agriculture is no real help to environmental improvement.

Agricultural support in the Organisation for Economic Co-operation and Development (OECD) member countries was estimated at \$300 billion in 1996, some 1.3% of GDP, although this represented a decrease from 2.2% in 1986–1988 (OECD, 1998). Support to agricultural producers fell from 45% in 1986–1988 to 36% in 1996, as measured by the percentage PSE. The falls have, however, mainly arisen as a result of rapid GDP growth and high agricultural world prices rather than from deliberate policy reform on subsidy removal.

Policy reform driven by international trade pressures from the Uruguay round of the GATT, and subsequently by the WTO, is shifting agricultural support away from market

price support and other support measures linked to farm input and output levels towards direct income support. Support which is decoupled from input and production levels does not have the built-in incentives to expand input use and production (and associated environmental externalities), but still aims to maintain farm incomes. Internationally, the policy instruments and levels of support vary widely by commodity and by country. However, market price support and support to inputs probably still account for over 60% of the total agricultural support worldwide. Agricultural subsidies thus stimulate high levels of input and natural resource use, wasteful production processes, and consequently, pollution. Reducing such subsidies is likely to reduce the costs of implementing environmental policy.

Agri-environmental schemes are a type of recent, new agricultural subsidy which is environmentally benign and helpful. These encourage land users to undertake agricultural practices with desired environmental results, rather than production enhancing outputs, such as public good provision (landscapes, flora and fauna habitats, biodiversity) or externality reduction. Support is coupled to the undertaking of particular environmentally beneficial farming practices to reward the farmer for the positive externalities that farming practices generate. Agri-environmental measures are being gradually introduced worldwide in developed countries in response to environmental pressures and political lobbying. Such schemes are, however, difficult to design, administer and monitor; frequently, they are merely a mechanism to compensate farmers for foregone market price subsidies. It is too early to determine what their long-term impacts on the environment will be and, in any case, their importance is dwarfed in comparison to market price support. For example, the UK spends approximately \$300 million per annum on agri-environmental schemes, whilst the Common Agricultural Policy payments to UK farmers are in the order of \$5 billion per annum.

Attempts to use subsidies to rectify market failures should follow the *polluter pays* principle, but rarely do. In terms of property rights, farmers are often assumed to have the right to pollute, and thus, have to be compensated for showing restraint. Likewise, governments have to compensate farmers for providing environmental goods in environmentally sensitive areas in the EU. This can be interpreted as the polluter gets rather than the polluter pays.

## SUBSIDY REFORM AND THE ENVIRONMENT

Agricultural subsidies in rich countries are maintained by import barriers and export subsidies, whilst the agricultural policies of poorer countries tend to discourage farm production. The effects of these agricultural policies on the natural environment are poorly understood and under-researched despite numerous recent empirical trade liberalization studies. Based on the results from his commodity simulation

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model of world agricultural markets, Anderson (1992) argues that agricultural trade liberalization and the associated subsidy reductions could reduce global environmental damage from farming.

Liberalization would lead to falling agricultural prices in rich countries, resulting in less use being made of farm chemical inputs that pollute the air, soil and water. Chemical fertilizer applications and the use of farm pesticides are strongly correlated with producer price incentives. Lower use of irrigation water would reduce soil salinity problems and reduced grain feeding of animals would reduce effluent disposal problems. Less intensive agricultural land use could result in more land being devoted to forestry, thus increasing the absorption of CO<sub>2</sub> from the earth's atmosphere.

Liberalization would, in turn, raise world agricultural prices and those in less developed countries (LDCs). This would make agricultural production in LDCs more profitable, increase the demand for farm labor and increase rural wages. Marginal workers could be attracted into the commercial sector, leaving behind subsistence practices on hillsides and resulting in less deforestation and soil degradation, particularly on sloping lands. The price of fuel wood might also rise due to increases in collecting costs causing the substitution of cleaner fuels, such as kerosene. Forests would thus be less depleted (80% of logs felled in LDCs are used as fuel). Higher royalty charges on logging and stronger enforcement of forestry property rights would help too. Optimal environmental policy instruments should be used in conjunction with the removal of distortions to agricultural output and input prices.

The WTO-related expansion of rice cultivation in non-Asian countries could lead to environmental problems in terms of water resources. Intensive cultivation of rice for exports would require expansion in irrigation and drainage infrastructures in Latin America and Africa. In designing such systems, particular attention will need to be given to the problems of water-induced paddy land degradation which have occurred in Asia, such as salinization, soil toxicity build-up and water logging.

Caution should, however, be exercised with respect to these conclusions. They are based on weak links between agricultural prices, production levels, input use, production technologies and environments. Differential population

pressures at local, regional and national levels can substantially change, modify and even invalidate the findings. Further research is required.

### CONCLUSIONS

Subsidy reform is now a central plank of the environmental policy and international trade agenda. International cooperation in reducing agricultural subsidies will facilitate support removal/reduction and reduce the negative side-effects that may accrue to any one country. Negotiating multilateral reduction of agricultural support which is common in many countries could lead to increased environmental benefits and reduced government expenditures, with little loss of competitive advantage in the agricultural sector of any one country. It is unclear whether the continued subsidy reduction and opening up of markets presents opportunities or threats to farmers in economically marginal, but ecologically valuable land, and what the impact on natural resource management might be. However, a simple message still remains: if you want to start saving the environment, stop financing its destruction by agricultural subsidization.

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