

DECREASING ENVIRONMENTAL POLLUTION THROUGH REDUCING ENVIRONMENTALLY DAMAGING SUBSIDIES: THE CASE OF AGRICULTURAL INPUT SUBSIDIES*

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ABSTRACT

Environmental pollution is the most typical example of negative externality regarded as one of the sources of market failure. Therefore, existence of environmental pollution requires government intervention in the economy in order to realize an efficient resource allocation. However, sometimes environmental pollution stems from some public policies intended to achieve non-environmental goals. This study reveals adverse effects of agricultural input subsidies, one of the public policies, on the environment and implies that reduction or removal of these subsidies is necessary to improve the environment. Given some economic, political and social barriers, the success of such policy entails balancing environmental policy objective with non environmental policy objectives.

Keywords: *Externality, Input Subsidy, Market Failure, Market Based Instruments, Pollution.*

Introduction

Environmental pollution from water pollution, air pollution to land pollution caused by production and consumption activities can be addressed via a wide range of policy instruments such as regulatory instruments and economic instruments. Subsidies used to address environmental pollution are included in economic instruments or market based instruments. Subsidies can be classified into three types: Pigovian subsidies, indirect subsidies and reduction of environmentally damaging subsidies or environmentally harmful subsidies.

This study assesses theoretically the interactions between agricultural input subsidies, a type of environmentally damaging subsidies, and environmental

* Because this study was published mistakenly paragraph omitted by printing house in Volume 3, Number 2, this study has been reprinted.

pollution. This study also examines the effects of reduction of agricultural input subsidies on the environment. Section 1 presents brief information related to agricultural input subsidies. Section 2 evaluates adverse impacts of agricultural input subsidies on the environment. Section 3 examines effects of agricultural input subsidy reduction on the environment. Section 4 illustrates trends in reduction or removal of agricultural input subsidies. Section 5 discusses some barriers to subsidy reduction policy. Conclusions are presented in the final section.

1. Agricultural Input Subsidies

Environmentally damaging subsidies are implemented generally in order to achieve non-environmental policy goals, and have adverse impacts on the environment.¹ Environmentally damaging subsidies are grouped into energy subsidies, agricultural subsidies (agricultural input subsidies, output subsidies, etc.) and transport subsidies.

Agricultural input subsidies crucial instruments of the green revaluation strategy of development in the early 1960s are provided to influence the quantities and combinations of purchased inputs. However, increasing use of agricultural inputs can compound environmental pollution. Agricultural input subsidies having adverse effects on the environment consist of pesticide subsidies, fertilizer subsidies and irrigation subsidies. These subsidies are implemented in many countries, developing countries and developed countries alike.

In general, agricultural input subsidies are justified on some grounds such as:²

- Asymmetric Information. Input subsidies reduce risk of farmers' underestimation of their benefits and underutilization of new technologies due to information asymmetries
- Income distribution. Input subsidies permit increase in agricultural production which in turn keeps foods prices low. Therefore, input subsidies would be of particular benefit to the poor.
- Financial difficulties. Input subsidies overcome financial difficulties stemming from existence of poorly developed capital markets. With input subsidies, farmer's access to new techniques including the use of fertilizers, pesticides, and so forth gets easy.
- Positive externality. The successful adoption of new technology by one farmer provides valuable information to his/her neighbors. Because of existence of this positive externality, input subsidies are needed.

¹ C. van Beers and J. van den Bergh, "Perseverance of Perverse Subsidies and Their Impact on Trade and The Environment", *Tinbergen Institute Discussion Paper*, TI 2000-05/3, Amsterdam: Tinbergen Institute, 2000, p. 4.

² K. Griffin, *Alternative Strategies for Economic Development* (Great Britain: St. Martin Press, 1989), pp. 144-146, S. Gupta, K. Miranda, and Parry, I., "Public Expenditure Policy and The Environment: A Review and Synthesis" *World Development*, Vol. 23, 1995, pp. 517-518, J.E. Stiglitz, "Some Theoretical Aspects of Agricultural Policies" *Research Observer* 2, No.1, 1987, pp. 43-44, F. Ellis, *Agricultural Policies in Developing Countries*, (Great Britain: Cambridge University Press, 1992), pp. 127-128.

- Domestic industry. Input subsidies are provided in order to maximize the use of domestic rather than imported supplies of farm inputs, either across the board, or in specific product lines.

Measuring the size of agricultural input subsidies is a difficult task since these subsidies are taken different forms³. However, some values in selected countries can be given to display the importance of agricultural input subsidies. For example, fertilizer subsidies in 1985 were about \$221 million in Indonesia in 1986-1987⁴. Pesticide subsidies in Colombia, Egypt, and China were \$207 million, \$69 million and \$285 million respectively⁵. As percentage of total retail costs, pesticides were heavily subsidized in many developing countries such as Senegal (89%), Egypt (83%) and Indonesia (82%) in 1985⁶. Annual irrigation subsidies were estimated at between \$2 billion and \$2.5 billion in the United States and were estimated at between \$20 billion and \$25 billion in developing countries⁷. In addition, agricultural input subsidies of Turkey were \$74.6 million - \$59.8 million fertilizer subsidy and \$14.8 million pesticide subsidy in 2001⁸.

2. Impacts of Agricultural Input Subsidies on Environmental Pollution

Agricultural input subsidies that encourage use of agricultural inputs inevitably have adverse effects on the environment. As shown in Table-1, some adverse effects stemming from agricultural input use include water logging, salinization, air pollution, land pollution, water pollution, and so on. While adverse effects of input use originating from input subsidies on the environment are certain, the extent of the effect is not certain. The extent of the effect varies to the responsiveness of input use to changes in subsidies and the amount of damage caused by each unit of input use⁹.

Figure-1 illustrates adverse effects of agricultural input subsidies on the environment. The upper panel of the figure shows effects of input subsidy on input use and the lower panel of the figure shows effects of input use on environmental pollution. Since the environment has assimilative capacity for emissions to some extent, environmental pollution curve (Ec) is not driven from origin. As shown in Figure-1, farmers use input to the point (Q0) at which marginal revenue product

³ J. P. Barde and O. Honkatukia, "Environmentally Harmful Subsidies" (Contribution to the ERE 2003 Yearbook), Paris: OECD, 2003, pp. 5-6.

⁴ E.B. Barbier, "Cash Crops, Foods Crops, and Sustainability: The Case of Indonesia." *World Development*, vol. 17, no. 6, 1989, p. 888.

⁵ Gupta, Miranda, and Parry "Public...", p. 519.

⁶ E.B. Barbier and J.C. Burgess, "Agricultural Pricing and Environmental Degradation" *The World Bank Policy Research Working Paper*, 0960, Washington D.C: World Bank, 1992, p. 10.

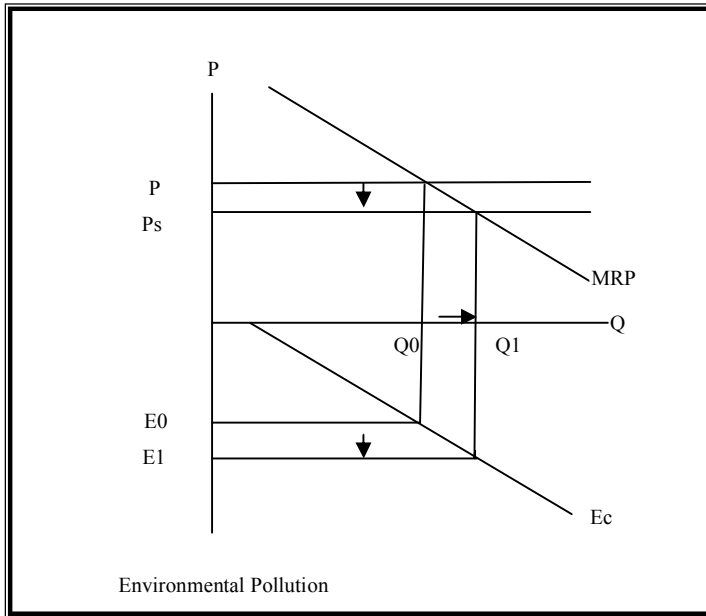
⁷ A. De Moor and P. Calamai, *Subsidizing Unsustainable Development: Undermining the Earth with Public Funds*, (Canada: Earth Council, 1997), p. 15.

⁸ R. Yeni and C. Dölekoğlu,, "Tarımsal Destekleme Politikasında Süreçler ve Üretici Transferleri, (Ankara:TEAE,2003), pp. 21-24.

⁹ World Bank (1997a), "Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development", *Environmentally Sustainable Development Studies and Monograph Series*, No: 17, Washington D.C, World Bank, 1997, p. 41.

(MRP) is equal to marginal factor cost or price. If a subsidy on input use is provided, the price of input drops from P to P_s . A drop in the net price paid by farmers induces farmers to use more of input, so the quantity of input used rises from Q_0 to Q_1 , which in turn causes environmental pollution to increase from E_0 to E_1 .

Figure 1:
Agricultural Input Subsidies and Environmental Pollution



Source: Author's illustration.

Looking at separately, each subsidy has a variety of adverse effects on the environment by increasing use of agricultural inputs. Fertilizers subsidies lead to contamination of oil, air and water, depletion of soil productivity, erosion, deforestation and so on. More use of pesticides may increase resistance of pests, kill pest predators and cause land, air and water pollution. Excessive use of water results in water logging, salinization and pollution of water and land. Table-1 illustrates these adverse effects.

Table 1:
Impacts of Agricultural Input Subsidies on the Environment

Type of Subsidy	The Mechanism through Which It May Harm the Environment	How It May Harm Environment
Fertilizer Subsidy	Excessive use of fertilizer and inefficient application management practices	<ul style="list-style-type: none"> • Contamination of soil, air, surface water and ground water aquifers. • Contribution to global warming as a source of greenhouse gases in the long run • Depletion of future soil productivity, which in turn leads to soil erosion, deforestation and so on.
Pesticide Subsidy	Excessive use of pesticide and inefficient application management practices	<ul style="list-style-type: none"> • Resistance of pests to pesticides, so more pesticide use and more pollution • Killing off pest predators, thereby increasing survival rate of remaining pests, and hence incidence of pest problems in the future. • Pollution of air, surface water, ground water aquifers and land
Irrigation Subsidy	Excessive use of water and inefficient application management practices	<ul style="list-style-type: none"> • Water logging • Salinization • Pollution of surface water, ground water aquifers and land.

Source: Adapted from M. Sur, D.Umali - Deininger, and A. Dinar, "Water-Related Subsidies In Agriculture: Environmental And Equity Consequences", Paris: OECD, 2002 and P.B. Tinker, "The Environmental Implications of Intensified Land Use in Developing Countries" *Phil. Trans. R.Soc. Lond. B.*, 1997.

3. Reducing Agricultural Input Subsidies and Environmental Pollution.

One of the reasons of government intervention in the economy is existence of negative externality such as environmental pollution. With negative externality, the prices in a market do not reflect the true marginal costs associated with the goods and services traded in the market. However, the underlying causes of environmental pollution are not always ascribed to market failure. Sometimes some government policies intended to achieve non-environmental goals aggravate environmental pollution caused by market failure¹⁰. In other words, government policies pursue non-environmental goals such as promoting income distribution, stimulating domestic input industries, and so on cause unintended but significant adverse impacts on the environment. In general, the most commonly cited government policies that increase environmental pollution are related to public expenditure policies such as environmentally damaging subsidies¹¹. These subsidies unlike other subsidies

¹⁰ World Development Report (WDR), *Development and Environment*, (U.S.A: Oxford University Press, 1992) pp. 64-65.

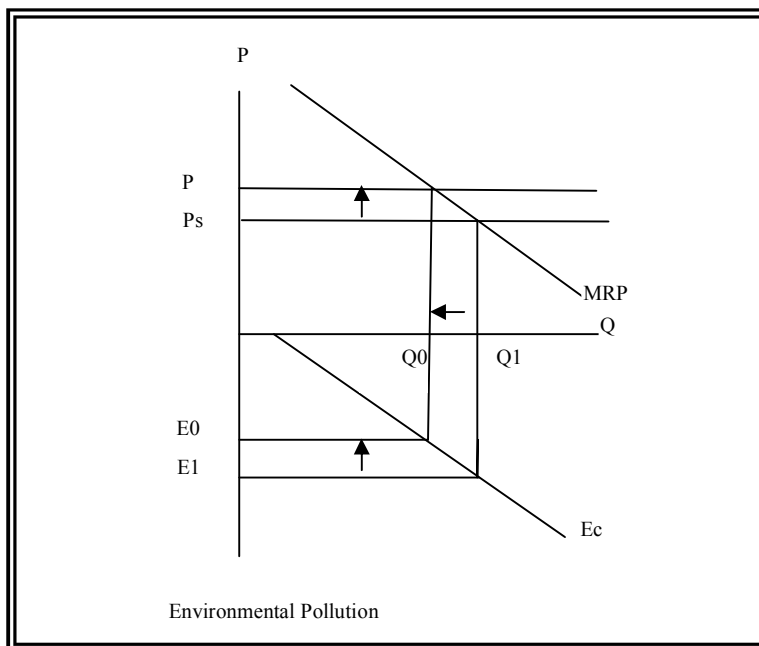
¹¹ Gupta, Miranda and Parry, "Public...", p. 515.

exacerbate rather than lessen environmental pollution¹². Therefore, environmentally damaging subsidies including agricultural input subsidies should be decreased in order to cope with environmental pollution.

Figure-2 illustrates how environmentally damaging agricultural input subsidy reduction reduces environmental pollution. Reduction or removal of agricultural input subsidies results in an increase in the input price from P_s to P . Increase in the price decreases input use from Q_1 to Q_0 , which in turn reduces environmental pollution from E_1 to E_0 because input subsidy reduction induces farmers to use less of input.

Figure 2:

Reducing Agricultural Input Subsidies and Environmental Pollution



Source: Authors' illustration

Some studies have examined effects of reduction or removal of agricultural input subsidies on the environment. Although no data exist to quantify the magnitude of the environmental impacts of the subsidy reduction or removal, the significant drop in agricultural input use is thought to have alleviated damage to the environment. These studies mostly on fertilizer and pesticide subsidies produce mixed environmental outcomes. While most of the studies reveal positive results, some studies reveal negative results. Table-2 displays these results.

¹² I.W.H. Parry, "A Second Best Analysis of Environmental Subsidies", *International Tax and Public Finance*, 5, 1998, pp. 153-154.

Table 2:
Selected Studies on Impacts of Subsidy Reduction or Removal

Study	Type of Subsidy	Environmental Impacts
IFPRI (2001)	Reduction or elimination of fertilizer subsidies in most Sub-Saharan Africa countries in 1980s.	Fertilizer use increased ten-fold in Benin and 30%in Malawi depending on how devaluations have affected prices for the major crops grown in the country.
Steen (2000)	Fertilizer subsidy reduction in Finland.	Nitrogen-based fertilizer use decreased from 92 kg per hectare in 1995 to 82 kg per hectare in 1999 and a 50% drop phosphate fertilizer use per hectare in the same period.
Soedjais (1999)	Fertilizer subsidy removal in Indonesia in 1999.	The price of urea increased 150% and consumption decreased 30% compared with the previous year.
OECD (1998)	Fertilizer subsidy removal in New Zealand	Fertilizer sales fell sharply in response to subsidy removal, but they begun to increase rapidly again in the early 1990s in response world market prices and were back up to the 1983 level by 1994.
World Bank (1997a)	Fertilizer subsidies were phased out in Bangladesh in 1978- 1983.	Fertilizer use increased 10% annually from 1970-1990 due to improved efficiency in distribution, increased domestic production and decreases in world urea prices in the mid-1980s.
World Bank (1997b)	Pesticide subsidies were phased out in Indonesia in 1986-1990	Pesticide production in Indonesia dropped to 22,100 metric tons in 1999 and meanwhile pesticide imports fell to a third of mid-1980s levels
Tolman (1995)	Fertilizer and pesticide subsidy reduction or removal	50% decline in agricultural subsidies would result in a 17% reduction in pesticide use and 14% reduction in fertilizer use. Complete removal of agricultural subsidy would result in a 35% reduction in total chemical use per hectare and 29% reduction in total fertilizer use per hectare
Barker et al., 1985	Fertilizer subsidy reduction or removal	The elasticity of fertilizer demand for 11 Asian countries varies between 0.4 and 0.7 in the short run, even higher in the long run. This means that the decrease in both fertilizer use and environmental pollution from subsidy reduction or removal can be predicted.

Source: G. Porter, "Subsidies and the Environment: The State of the Knowledge" in *Environmentally Harmful Subsidies: Policy Issues and Challenges*, (Paris:OECD,2003), World Bank (1997a), "Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development" *Environmentally Sustainable Development Studies and Monograph Series*, No:17, Washington D.C: World Bank,1997, World Bank (1997b), "Five Years after Rio Innovations in Environmental Policy", *Environmentally Sustainable Development Studies and Monograph Series*, No:18 ,Washington D.C: World Bank ,1997.

4. Trends in Reduction and Removal of Agricultural Input Subsidies.

In general, many countries in the world began to reduce agricultural input subsidies during 1980s. As shown in Table-2, Bangladesh phased out fertilizer subsidies in 1978 – 1983. Indonesia removed fertilizer subsidies in 1999 and phased out most pesticide subsidies in 1986-1989. The Philippines and Sri Lanka removed fertilizer subsidies in 1988-1990¹³. Ecuador completely phased out pesticide and fertilizer subsidies¹⁴. New Zealand removed irrigation subsidies in 1988¹⁵. Australia reduced irrigation subsidies in 1994¹⁶. Turkey removed completely fertilizer and pesticide subsidies in 2001¹⁷.

Today, trend in reduction and removal of agricultural input subsidies still lasts in many countries and the main factors stimulating this trend are mostly non-environmental factors containing financial burden in many African and Latin American countries, the need for improved efficiency and requirements of structural adjustments programs¹⁸. Especially, economic crises in most developing countries have increased importance of non- environmental factors in recent years and led to reduction or removal of agricultural input subsidies.

5. Barriers to Reducing Agricultural Input Subsidies

Agricultural input subsidy reduction policy can improve the environment. Therefore, subsidy reduction policy is one of the plausible ways of reducing environmental pollution. However, some economic political and social barriers limit the effectiveness of using such a policy

Economic barriers include:

- Reducing agricultural input subsidies is likely to harm output especially in the short run. Even though such policy may decrease output per hectare in the short run, some output losses can be compensated by improving soil structure and productivity with the application of organic inputs such as organic fertilizer in the long run¹⁹. In addition, if output of other sectors harmed by environmental pollution increases through subsidy reduction policy, this leads to increased output, as well. The net effect depends on which effect outweighs the other.

¹³ World Bank, “Expanding...”, p. 58.

¹⁴ R.N. Stavins, “Experience with Market-Based Environmental Policy Instruments”, Prepared for *The Handbook Environmental Economics*, Edited by K.G.Maler and J.Wincent (Amsterdam: North Holland-Elsevier Science, 2001), p. 40.

¹⁵ OECD, “Water Subsidies and Environment”, Paris: OECD, 1997, p. 21.

¹⁶ J.Humphreys, M. Van Bueren and A. Stoeckel, *Greening Farm Subsidies: The Next Step in Removing Perverse Farm Subsidies*, (Australia: RIRDC Publication, 2003), p. 38.

¹⁷ Yeni and Dölekoğlu, *Tarimsal...*, pp. 21-23.

¹⁸ World Bank “Expanding...” p. 57.

¹⁹ Gupta, Miranda and Parry, “Public...”, p. 525.

- Reducing agricultural input subsidies would improve the fiscal balance by decreasing government expenditure. However, if such a subsidy reduction policy contracts the tax base by reducing output especially in the short run, thereby reducing tax revenues, which in turn may deteriorate fiscal balance.
- Reducing agricultural input subsidies may harm balance of payments. If agricultural output decreases due to the reduction or removal of subsidies, thereby increasing food imports, balance of payments may worsen²⁰. Moreover, subsidy reduction may deteriorate balance of payments through decreasing exports by increases in production costs.
- If subsidy reduction decreases output, employment may decrease, as well. Moreover, if capital intensive employment is preferred, even increases in output through subsidy reduction policy may lead to decrease in employment.

A probable adverse effect of subsidy reduction policy on income distribution is the main social barrier. Reducing agricultural input subsidies increase food prices due to adverse effects of reducing agricultural input subsidies on production in the short run. Therefore, income distribution may improve in favor of the rich.

Rent seeking behavior constitutes a political barrier against subsidy reduction policy. Reduction or removal of agricultural input subsidies can harm interests of the benefited groups. Therefore, such vested interests can create much opposition against the reduction or removal of agricultural input subsidies²¹.

6. Conclusion

This discussion attempts to illustrate both the potential adverse effects of agricultural input subsidies on the environment and the potential impact of subsidy reduction on the environment.

The discussion reveals that agricultural input subsidies have significant effects on the environment. Therefore, reduction of the overall size of the subsidies or removal of them completely should be pursued. As a result of this, many countries decreased or removed agricultural input subsidies.

On the one hand, pursuing this sort of policy is a difficult task. Given economic, political and social barriers against subsidy reduction policy, success of such policy requires balancing environmental policy objective with non-environmental policy objectives. Therefore, the preparation stage of policy package has a vital importance. Environmental policy objectives should be presented clearly and understandably. In addition, potentially affected parties should be consulted at the preparation stages. Early announcement of policy details and gradual implementation of subsidy reduction policy also help affected parties to adopt the new instruments. Moreover, if needed, modifications should also be made.

²⁰ Gupta, Miranda and Parry, "Public...", p. 525.

²¹ van Beers and van den Bergh, "Perseverance...", p. 14.

No doubt, subsidy reduction or removal policy benefits the environment. Nonetheless, such policy does not ensure socially optimal pollution level in which external costs are internalized because producers (farmers) have no incentive to internalize external costs even in the absence of agricultural input subsidies. Therefore, effectiveness of subsidy reduction policy requires complementary use of other policy instruments such as environmental tax, regulations, and so on.

This study has some limitations on effects of reduction or removal of environmentally harmful agricultural input subsidies. More research is needed to better understand the magnitudes of reduction or removal of agricultural input subsidies in terms of their direct effects on the environment and better distinguish the effects of input subsidy reduction or removal from the effects of other policy variables such as exchange rate, interest rate and so on. Therefore, further studies should be focused on these issues.

