Does Agricultural Trade Liberalization under FTA Reduce Pollution from Agriculture? : The Case of the Japan-Korea FTA

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Abstract

The purpose of this paper is to contribute to the debate over agricultural trade and environment by asking: Does agricultural trade liberalization under free trade agreement (FTA) reduce pollution from agriculture? In order to contribute to answering the above research question, we measure the potential impact of environmental pollution from agriculture caused by agricultural trade liberalization under the Japan-Korea FTA (JKFTA), using the Global Trade Analysis Project (GTAP) model and the OECD Nitrogen Balance Database. The scenario we model assumes the complete removal of all import tariffs between Japan and Korea, not only in the agricultural sector but in non-agricultural sectors, as well. The results show the JKFTA is likely to lead to an overall increase in the total nitrogen surplus for Japan and Korea. Therefore, our results suggest that agricultural trade liberalization under FTA does not reduce the potential pollution from agriculture in the case of the JKFTA.

1. Introduction

The number of regional and bilateral free trade agreements (FTAs) is increasing all over the world. There has been a rapid surge in FTAs in the Asia-Pacific region. Negotiations for a Japan-Korea FTA—which would be the first among developed countries in Northeast Asia—began in 2003, and six rounds of negotiations were held. However, no negotiations have been held since the end of the sixth round in November 2004. The issue of agricultural trade liberalization, including the removal of import tariffs, is said to be one of the reasons why negotiations of the Japan-Korea FTA (JKFTA) have stalled.

The Japanese government seems reluctant to reduce Japan's agricultural trade barriers, because Korea is likely to have a comparative advantage in agricultural production compared to Japan. However, both Japan and Korea have a comparative disadvantage in agricultural production compared to relatively land-abundant developed countries such as the United States and Australia, or relatively labor-abundant developing countries such as China. Therefore, Japan and Korea have been using tariff and non-tariff trade barriers in order to increase domestic producer prices of agricultural products and increase domestic agricultural production. Increased producer prices have led to more intensive agricultural systems in Japan and Korea. The expansion in production and the development of intensive agricultural systems in Japan and Korea have caused concerns over environmental degradation, such as water and atmospheric pollution, due to more manure from livestock and more nitrogenous fertilizers used in cropping. Figure 1 shows Japan's (the fourth-highest) and Korea's (the highest) nitrogen surpluses (kgN/ha) are quite high among OECD countries (OECD, 2001). Much of this large nitrogen surplus will end up in the water environment and contribute to eutrophication.

3

Whether agricultural trade liberalization will have a positive or negative impact on the natural environment is an empirical matter. Several previous empirical studies seek to quantify the impact of agricultural trade liberalization on environmental pollution from agriculture (Anderson and Blackhurst, 1992). There have also been studies on the possible economic and environmental impact of the JKFTA. Nakajima (2002) measured the likely economic impact caused by the JKFTA, using the Global Trade Analysis Project (GTAP) model (Hertel, 1997). However he did not measure the environmental impact. While Kang and Kim (2004) measured both the economic and environmental impact in Korea, using the GTAP model and Korean air pollution inventories, they did not measure the environmental impact in Japan. As far as we know, no attempt has been made to measure the impact of agricultural trade liberalization under the JKFTA on environmental pollution from agriculture in both Japan and Korea.

The purpose of this paper is to contribute to the debate over agricultural trade and environment by asking: Does agricultural trade liberalization under FTA reduce pollution from agriculture? In order to contribute to answering the above research question, we measure the potential impact of environmental pollution from agriculture caused by agricultural trade liberalization under the JKFTA, using the GTAP model and the OECD Nitrogen Balance Database (OECD, 2001).

This paper is organized as follows. In section two, we outline the data and models used in this paper. In section three, we present the simulation results. Finally, in section four we give our summary and concluding remarks.

2. Data and model

We measure the potential economic and environmental impact caused by the JKFTA using the GTAP model and the OECD Nitrogen Balance Database (Rae and Strutt 2004, 2007).   First, the GTAP model is used to estimate the changes in economic activities, such as agricultural production, caused by the JKFTA.   Second, the GTAP results and the OECD Nitrogen Balance Database are used to estimate the potential impact of environmental pollution from agriculture caused by the JKFTA.

2.1 The trade model and liberalization scenario

We use a standard static version of the GTAP model to estimate the potential economic impact of an FTA between Japan and Korea.   This model measures the static impact of trade policy changes without incorporating dynamic effects.

Version 5.4 of the GTAP database is used in this analysis.   It divides the world into 78 regions, each containing 57 sectors or commodities.   Since this study focuses on a bilateral FTA between Japan and Korea, the database is aggregated into 24 regions and 14 sectors, as shown in Tables 1 and 2.   This regional aggregation is designed to distinguish the OECD countries, for which nitrogen balances are available, and the non-OECD regions. Three regional groupings of Central and South America, the Rest of Asia and the Rest of the World are used to represent non-OECD countries.   Nitrogen balances are not available for these groupings.   The commodity aggregation framework is designed to focus on the farm sectors for which nitrogen balances are computed.   In terms of the aggregated commodities in Table 2, the farm sector is defined as commodities from No. 1 (rice) to No. 7 (other livestock).

As seen in Table 3, high tariffs remain on farm and food sectoral commodities in Japan and Korea. The highest Japanese tariffs on imports from Korea are levied on rice (409%). Commodities whose tariffs are higher than 50% in Japan are rice, wheat, cattle and sheep, other meat and dairy products. The highest Korean tariffs on imports from Japan are levied on other crops (304%). Commodities whose tariffs are higher than 50% in Korea are cereal grain, other crops and rum meat.

The scenario we model assumes the complete removal of all import tariffs between Japan and Korea, not only in the agricultural sector but in non-agricultural sectors, as well. While it is unlikely that the JKFTA would remove all import tariffs in all sectors between Japan and Korea, this scenario provides an upper bound of the economic impact caused by the possible JKFTA.

2.2 The nitrogen model and its linkage to the trade model

We focus only on nitrogenous pollution from agriculture, due to the limitation of available data on other kinds of pollution, such as SOx, NOx, etc. The nitrogen balance is used to estimate the potential changes in nitrogenous pollution from agriculture caused by the JKFTA. The nitrogen balance is defined by OECD as the physical difference (surplus/deficit) between nitrogen inputs into, and outputs from, an agricultural system, per hectare of agricultural land (OECD, 2001a). As shown in figure 2, the annual total quantity of inputs for the soil surface nitrogen balance includes fertilizer, livestock manure, and other nitrogen inputs[1]. The annual total quantity of uptake for the soil surface nitrogen balance includes harvested crops, and forage and pasture.

We use the OECD Nitrogen Balance Database for 1997, corresponding to the base

year of version 5.4 of the GTAP database used. This very detailed information is aggregated into a form compatible with the GTAP database used. The OECD database includes OECD country data on nitrogen coefficients for crops and livestock.

Nitrogen inputs and outputs are calculated as the relevant quantity of crop outputs or livestock numbers multiplied by nitrogen coefficients in the OECD Nitrogen Balance Database. We assume that these coefficients will remain constant when trade is liberalized, and that the level of nitrogen inputs and outputs will change by the same proportion as the levels of crop outputs or livestock numbers (Rae and Strutt 2004, 2007).

3. Results

3.1 Impact on GDP and farm outputs

The impact on real GDP and total farm output under full trade liberalization between Japan and Korea is shown in Table 4.

Under full trade liberalization, Korea is likely to experience a more substantial gain in real GDP and total farm output than Japan. The impact of full trade liberalization is more observable in total farm output than in real GDP. As shown in Table 4, under full trade liberalization real GDP in Korea expands by 0.21%, whereas real GDP in Japan declines by 0.01%. Total Farm output in Korea expands by 2.67%, whereas total farm output in Japan declines by 0.16%.

As shown in Table 5, under full trade liberalization farm production of most commodities slightly declines in Japan, while output from the livestock sector and the rice sector exhibits some expansion in Korea. In percentage terms, the decline in output from the cattle and sheep sector is the highest (-0.78%) in the farm sectoral outputs of Japan.

The increase in output from the milk sector is the highest (9.93%) in the farm sectoral outputs of Korea.   Output from the other livestock sector and the rice sector in Korea also expands by 9.08% and by 6.17%, respectively.

Nakajima (2002) estimated the potential economic impact of the JKFTA using the GTAP model and found results similar with ours.   His results also show that under full trade liberalization, Korea is projected to experience a more substantial expansion in real GDP and agricultural products than Japan.

3.2 Impact on nitrogen balances

The impact on nitrogen balance under the full trade liberalization between Japan and Korea is shown in Table 6.

While Japan's nitrogen balance is projected to decrease, the extent of the decrease is rather small.   Japan's nitrogen balance is projected to decrease by only 0.3% from the initial level of nitrogen surplus.   While our results show a decreased level of nitrogen uptake (0.2%), the decrease in nitrogen inputs (0.3%) is slightly larger in magnitude.   The small decrease in each farm sectoral output results in a small decrease of uptake and inputs, leading to a rather small decrease in Japan's nitrogen balance.

Korea's nitrogen balance is projected to increase by 5.4% from the initial level of nitrogen surplus.   While our results show an increased level of nitrogen uptake (2.7%), the increase in nitrogen inputs (4.4%) is much larger in magnitude.   The increased inputs from fertilizer and livestock manure are the key driving force behind the anticipated deterioration in the overall nitrogen balance of Korea.   This arises mainly due to the large increases in output from the rice sector and the livestock sector.   Results comparable to those presented

here were reported by Kang and Kim (2004). They analyzed not nitrogen balance but air pollution, such as SOx and NOx levels in Korea's 26 industry sectors caused by the JKFTA. They used the GTAP model and Korean air pollution inventories to give a quantitative analysis of trade and environmental linkage only in Korea. Their results show Korea's air pollution from the agricultural sector (including the fishing and forest sectors) is projected to increase while overall air pollution from all sectors is projected to decrease.

The total nitrogen balance of Japan and Korea is projected to increase by 2.2% from the initial level of nitrogen surplus[2]. While our results show an increased level of nitrogen uptake (0.6%), the increase in nitrogen inputs (1.5%) is much larger in magnitude. The increased inputs from fertilizer and livestock manure in Korea are the key driving force behind the anticipated deterioration in the overall nitrogen balance. This arises mainly due to the large increase in outputs from the rice sector and the livestock sector in Korea.

In sum, our results show the JKFTA is likely to lead to an overall increase in the total nitrogen surplus for Japan and Korea. Therefore, our results suggest that agricultural trade liberalization under FTA does not reduce the potential pollution from agriculture in the case of the JKFTA.

4. Conclusions

We measure the potential economic and environmental impact caused by a Japan-Korea FTA (JKFTA) using the GTAP model and the OECD Nitrogen Balance Database. The scenario we model assumes the complete removal of all import tariffs between Japan and Korea, not only in the agricultural sector but in non-agricultural sectors, as well.

The GTAP results show that farm outputs increase significantly in Korea and decrease slightly in Japan. Farm production of most commodities slightly declines in Japan, while outputs from the livestock sector and the rice sector exhibit significant expansion in Korea.

The nitrogen balance results show that the possible JKFTA have a relatively greater impact on the environmental pollution from agriculture in Korea than in Japan. The JKFTA is likely to lead to an overall increase in the total nitrogen surplus for Japan and Korea. Therefore, our results suggest that agricultural trade liberalization under FTA does not reduce the potential pollution from agriculture in the case of the JKFTA.

Our results should be treated as preliminary due to inevitable limitations with this kind of research. We briefly raise some issues regarding the further research required. First, we focused only on nitrogenous balance as an indicator of potential pollution from agriculture, due to the limitation of available data. Second, we did not introduce changes of environmental policies in Korea and Japan into our models. Third, we analyzed only national levels of potential pollution. The analysis on local levels of potential pollution from agriculture will also be required because both national and local levels of analyses are necessary in order to know whether agricultural trade liberalization will reduce or increase pollution from agriculture totally.

Notes:

1 In our paper, fertilizer means inorganic fertilizer; livestock manure means net livestock manure; other nitrogen inputs include biological nitrogen fixation, atmospheric deposition, and seeds and planting materials.

2 The JKFTA is likely to lead to not only a significant overall increase in the total nitrogen

balance for Japan and Korea, but also a slight overall increase in the total nitrogen

balance for all OECD countries.   Our results show total nitrogen balance for OECD

countries increases by 0.03%.

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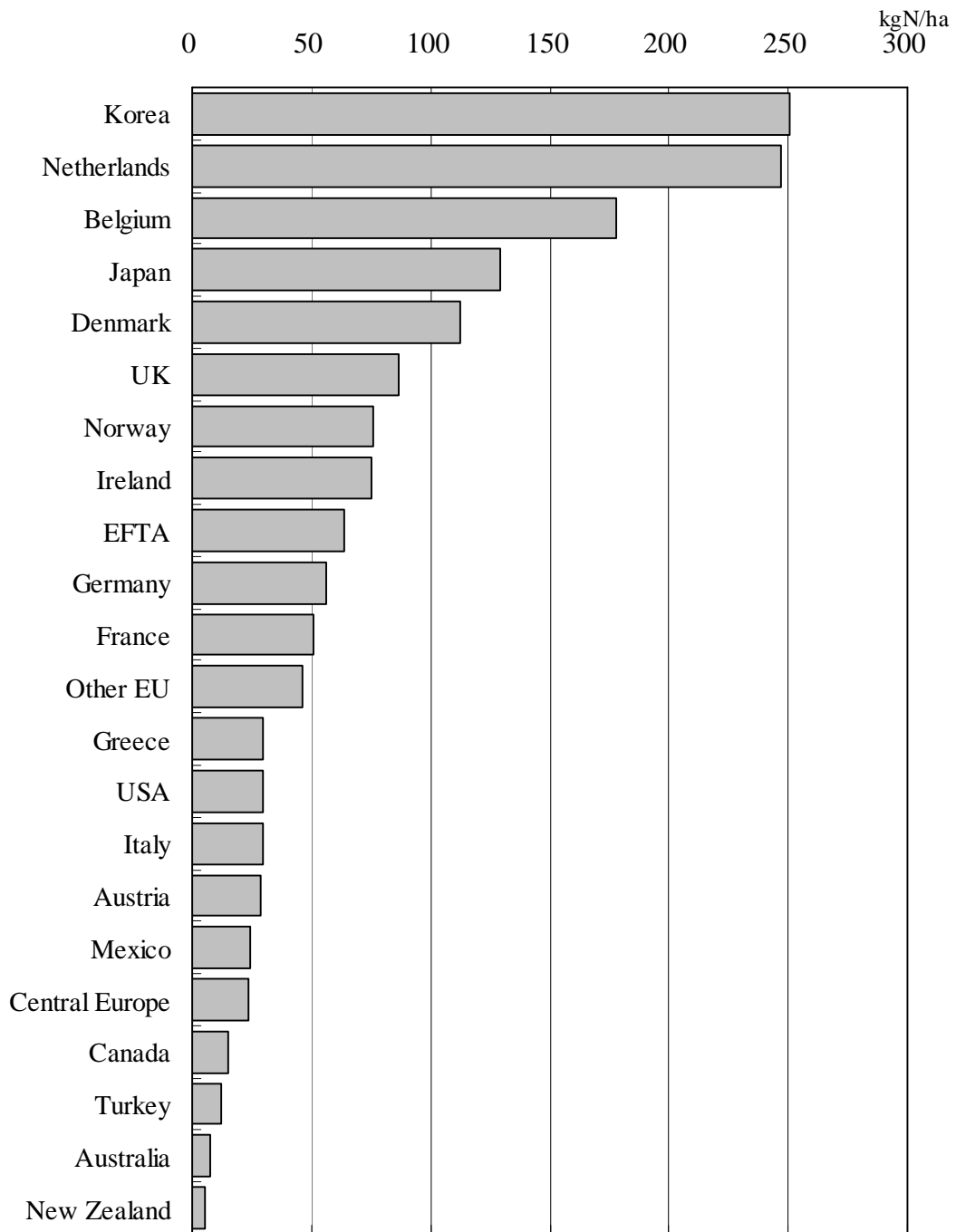
Figure 1 Nitrogen Balance by Region (kgN/ha)

Source: OECD (2001).

Table 1 Regional Aggregation

No.	Aggregated Region	GTAP Region
1	Japan	Japan.
2	Korea	Korea.
3	Australia	Australia.
4	New Zealand	New Zealand.
5	USA	United States.
6	Canada	Canada.
7	Mexico	Mexico.
8	Austria	Austria.
9	Belgium	Belgium.
10	Denmark	Denmark.
11	France	France.
12	Germany	Germany.
13	Greece	Greece.
14	Ireland	Ireland.
15	Italy	Italy.
16	Netherlands	Netherlands.
17	UK	United Kingdom.
18	Other EU Countries	Finland; Luxembourg; Portugal; Spain; Sweden.
19	Central Europe	Czech Republic; Hungary; Poland; Slovakia.
20	EFTA	Switzerland; Rest of Eur Free Trade Area.
21	Turkey	Turkey.
22	Rest of Asia	China; Hong Kong; Taiwan; Indonesia; Malaysia; Philippines; Singapore; Thailand; Vietnam; Bangladesh; India; Sri Lanka; Rest of South Asia.
23	Central and South America	Central America, Caribbean; Colombia; Peru; Venezuela; Rest of Andean Pact; Argentina; Brazil; Chile; Uruguay; Rest of South America.
24	Rest of the World	Albania; Bulgaria; Croatia; Malta; Romania; Slovenia; Estonia; Latvia; Lithuania; Russian Federation; Rest of Former Soviet Union; Cyprus; Rest of Middle East; Morocco; Rest of North Africa; Botswana; Rest of South Afr C Union; Malawi; Mozambique; Tanzania; Zambia; Zimbabwe; Other Southern Africa; Uganda; Rest of Sub-Saharan Africa; Rest of World.

Source: Derived from Version 5.4 of GTAP Database.

Table 2 Commodity Aggregation

No.	Aggregated commodity	GTAP commodity
1	Rice	Paddy rice.
2	Wheat	Wheat.
3	Cerial grains	Cereal grains n.e.c.
4	Other crops	Vegetables, fruit, nuts; oil seeds; sugar cane, sugar beet; plant-based fibers; crops n.e.c.
5	Milk	Raw milk.
6	Cattle and sheep	Cattle, sheep, goats, horses.
7	Other livestock	Animal products n.e.c.
8	Rum meat	Meat: cattle, sheep, goats, horse.
9	Other meat	Meat products n.e.c.
10	Dairy products	Dairy products.
11	Other food	Vegetable oils and fats; processed rice; sugar; food products n.e.c; beverages and tobacco products.
12	Resource products	Wool, silk-worm cocoons; forestry; fishing; coal; oil; gas; minerals n.e.c.
13	Manufacturing products	Textiles; wearing apparel; leather products; wood products; paper products, publishing; petroleum, coal products; chemical,.rubber,.plastic prods; mineral products n.e.c; ferrous metals; metals n.e.c; metal products; motor vehicles and parts; transport equipment n.e.c; electronic equipment; machinery and equipment n.e.c; manufactures n.e.c.
14	Services	Electricity; gas manufacture, distribution; water; construction; trade; transport n.e.c; sea transport; air transport; communication; financial services n.e.c; insurance; business services n.e.c; recreation and other services; pubAdmin/defence/health/educat; dwellings.

Source: Derived from Version 5.4 of GTAP Database.

Note: N.e.c. stands for not elsewhere classified.

Table 3 Ad Valorem Tariffs on Different Commodities on Bilateral Basis (%)

Commodity	Japanese tariffs on imports from Korea	Korean tariffs on imports from Japan
Rice	409	5
Wheat	249	3
Cerial grains	20	304
Other crops	38	74
Milk	0	0
Cattle and sheep	149	31
Other livestock	5	10
Rum meat	36	75
Other meat	58	22
Dairy products	287	26
Other food	38	45
Resource products	7	10
Manufacturing products	2	8
Services	0	0

Source: Derived from Version 5.4 of GTAP Database.

| Fertilizer | Livestock manure | Other nitrogen inputs | | Nitrogen Inputs |

Agricultural Land → Nitrogen Balance

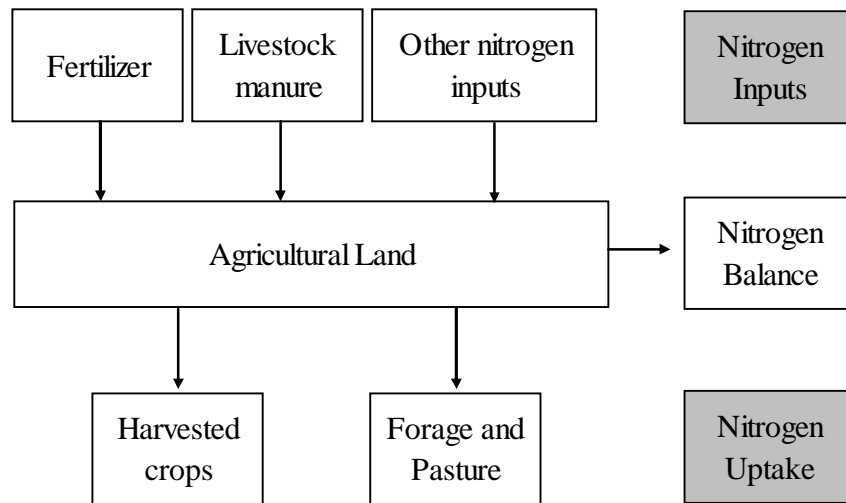| Harvested crops | Forage and Pasture | | Nitrogen Uptake |

Figure 2 Summary of the OECD Nitrogen Balance Mechanisms

Source: OECD(2001).

Note: Fertilizer means inorganic fertilizer; livestock manure means net livestock manure; other nitrogen inputs include biological nitrogen fixation, atmospheric deposition, and seeds and planting materials.

Table 4 Impacts of the JKFTA on Real GDP, and Total Farm Output (%)

	Japan	Korea
Real GDP	-0.01	0.21
Total Farm Output	-0.16	2.67

Note: All projections are percentage deviations from the initial period.

Table 5 Changes in Farm Sectoral Outputs (%)

	Japan	Korea
Rice	-0.21	6.17
Wheat	-0.76	-0.41
Cereal grains	-0.50	-3.18
Other crops	0.00	-1.47
Milk	-0.51	9.93
Cattle and sheep	-0.78	4.87
Other livestock	-0.20	9.08

Note: All projections are percentage deviations from the initial period.

Table 6 Impacts of the JKFTA on Nitrogen Balance (000tonnes, %)

		Initial 1997			JKFTA	
	Japan	Korea	Japan + Korea	Japan	Korea	Japan + Korea
Uptake						
Harvested crops	368.2	249.0	617.2	367.7 (-0.2)	255.3 (2.5)	622.9 (0.9)
Forage and Pasture	226.5	12.9	239.3	225.6 (-0.4)	13.6 (5.3)	239.2 (-0.1)
Total Uptake	**594.7**	**261.8**	**856.5**	**593.3 (-0.2)**	**268.8 (2.7)**	**862.1 (0.6)**
Inputs						
Fertilizer	568.5	446.0	1,014.5	567.1 (-0.2)	457.8 (2.7)	1,025.0 (1.0)
Livestock manure	487.6	272.5	760.1	485.7 (-0.4)	294.4 (8.0)	780.1 (2.6)
Other nitrogen inputs	179.3	40.8	220.1	179.3 (0.0)	40.7 (-0.4)	220.0 (-0.1)
Total Inputs	**1,235.3**	**759.3**	**1,994.7**	**1,232.1 (-0.3)**	**793.0 (4.4)**	**2,025.1 (1.5)**
Total Nitrogen Balance	**640.7**	**497.5**	**1,138.2**	**638.9 (-0.3)**	**524.2 (5.4)**	**1,163.0 (2.2)**

Note: Fertilizer means inorganic fertilizer; livestock manure means net livestock manure; other nitrogen inputs include biological nitrogen fixation, atmospheric deposition, and seeds and planting materials.