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**Study on fertilizer prices**

## **Background**

In the context of its programme of activities, the Organization gives particular attention to production factors that affect the profit margins of coffee producers in exporting countries. This document contains a study of recent trends in fertilizer prices and their impact on coffee production.

## **Action**

The Council is requested to note this document.

## **STUDY ON FERTILIZER PRICES**

### **Introduction**

1. While the availability of arable land is constantly diminishing, the world's population continues to grow. The demand for energy is also increasing, exerting pressure on cereal crops grown for the production of biofuels and thereby reducing the quantities available for human and animal consumption. In this context, fertilizers play an increasingly vital role in ensuring soil fertility. Fertilizers are compounds used to enrich soils and provide plants with essential nutrients to promote growth and improve yield. Plants need adequate nutrient elements for healthy growth in optimal conditions given their contribution to soil fertility.

2. The fertilizers that are used in agriculture can be classified in two main types: organic and inorganic (also called mineral). A third type, organo-mineral fertilizer, is a combination of the first two. Organic fertilizer can be of animal or plant origin and is derived from vegetable waste or by-products of animal farming, including manure. Chemical fertilizers were developed by the chemical industry from carbon and petroleum. Mineral fertilizers were developed using naturally occurring deposits of phosphates and potassium as well as chemically manufactured fertilizer. To indicate their difference from organic fertilizer, fertilizers of chemical origin are known as mineral fertilizers even though they have the same constituents. This report provides a survey of fertilizers used in coffee farming and changes in their prices. The following points will be covered:

- I. Supply and demand of fertilizers used in coffee farming
- II. Prices of fertilizers used in coffee farming
- III. Impact of fertilizer price changes on coffee production

### **I. SUPPLY AND DEMAND OF FERTILIZERS USED IN COFFEE FARMING**

#### **I.1 Production**

3. Fertilizers are produced, marketed and used throughout the world. In coffee farming, the nutrients most widely used to enrich soils and improve yields are mineral fertilizers, mainly nitrogen, phosphate and potassium (NPK). Secondary nutrients or oligo-elements are also used to enrich the soil; these include manganese, iron, boron and zinc.

4. These nutrients or fertilizers are used in many exporting countries to improve yields. Any natural or manufactured product containing at least 5% of one of the three main elements can be called a fertilizer. For coffee, as for many other crops, the three essential nutrients for optimal growth are nitrogen, phosphorus and potassium. These three key elements are usually joined together but specific combinations depend on many factors. There is no standard formula for mineral soil enrichment since this depends on the nature of the soils, the rainfall regime and the amount of rain, the age of coffee trees, and the genetic value of the selected plant material. Total production of the three major nutrients was estimated at 206 million tonnes in 2007.

**(a) Nitrogen fertilizers**

5. Nitrogen, designated by the chemical symbol 'N', plays a key role in the healthy growth of the coffee tree and the formation of new branches and leaves as well as in photosynthesis. Nitrogen fertilizers are produced by synthesizing ammonia with nitrogen from the air in combination with hydrogen derived from natural gas. This chemical process can be used to produce a number of substances, including urea, ammonium sulphate, ammonium nitrate and nitrate. Nitrogen fertilizers account for 59% of the world's fertilizer production. The main nitrogen fertilizers derive from ammonia and its derivative product, urea. This study uses the price of urea as a reference for nitrogen fertilizer prices. World production of urea totalled 131 million tonnes in 2007. Natural gas accounts for between 70% and 90% of the cost of producing ammonia. The main producers of nitrogen fertilizers are China, India, Pakistan, Canada, Indonesia, Russian Federation and the United States of America.

**(b) Potassium fertilizers**

6. Potassium, designated by the chemical symbol 'K', is necessary for fruit and seed formation. Potassium fertilizers, commonly known as potash, include potassium chloride, potassium sulphate, potassium carbonate etc. They are mainly derived from natural potassium deposits and account for around 17% of world fertilizer production. World production was around 38 million tonnes in 2007. The main producers are Canada, Russian Federation, and Belarus, which account for over 70% of world production. Germany, Israel, Jordan, the USA, China and Brazil are also significant producers.

**(c) Phosphate fertilizers**

7. As in the case of potassium fertilizers, phosphate fertilizers are mainly derived from natural rock deposits. Phosphates are a source of phosphorus, designated by the chemical symbol 'P'. Phosphorus is not a major nutrient requirement for coffee trees although it contributes to the development of roots, flowering and fructification. Phosphate fertilizers or phosphates ( $P_2O_5$ ) include single or ordinary superphosphates, triple superphosphates, natural superphosphates, etc. Phosphate fertilizers account for 24% of the world's total fertilizer production. The biggest phosphate deposits are found in North America, Morocco, Tunisia, Togo, Israel, Jordan, China and a number of islands in Oceania, namely Nauru, Banaba and Makatea. The world's major producers are China, the USA, Morocco, Russian Federation, Tunisia, Jordan, Brazil, Israel, South Africa, Syria, Senegal and Togo. World production of phosphate fertilizers totalled 37 million tonnes in 2007.

**I.2 Consumption**

8. World demand for fertilizers was estimated at around 197 million tonnes in 2007. The growth in world demand has played a significant role in the increase in fertilizer prices. In regional terms, fertilizer consumption is marginal in Africa, accounting for only 3.4% of

world consumption of nitrogen fertilizers, 2.5% in the case of phosphates and 1.6% in the case of potassium in 2007. The main fertilizer consumers in Africa are Egypt, South Africa and Morocco. The main consumption areas are South and Southeast Asia and North America (Table 1). The main consumers of fertilizer are China, India, Brazil and the USA. China, India and Brazil accounted for as much as 90% of the growth in world fertilizer demand in 2007.

**Table 1: Expected share of regional and sub-regional fertilizer consumption (2007/08 - 2011/12)<sup>1</sup>**

Regions and sub regions	Nitrogen		Potash		Phosphate	
	Share of world consumption	Annual growth	Share of world consumption	Annual growth	Share of world consumption	Annual Growth
	%		%		%	
World		1.4		2.4		2.0
Africa	3.4	2.9	1.6	2.0	1.6	1.0
North America	13.5	0.3	17.1	0.7	17.1	0.5
Latin America	6.3	2.4	17.5	2.9	17.5	2.8
West Asia	3.5	1.7	1.4	2.4	1.4	1.0
South Asia	19.6	2.2	10.9	4.2	10.9	3.5
East Asia	38.3	1.3	35.2	3.3	35.2	1.9
Central Europe	2.7	1.8	2.4	1.0	2.4	1.2
West Europe	8.4	-0.3	9.5	0.0	9.5	-0.7
East Europe and Central Asia	3.0	2.4	3.1	1.6	3.1	4.5
Oceania	1.4	4.9	1.3	2.1	1.3	1.7

Source: FAO, 1 July – 30 June

**Table 2: World fertilizer supply and demand<sup>2</sup>**

	2007/08	2008/09	2009/10	2010/11	2011/12
Total supply	206 431	212 225	219 930	230 334	240 711
Total demand	197 004	201 482	205 947	211 230	216 019
Surplus/(deficit)	9 427	10 743	13 983	19 104	24 692

In thousand tonnes

Source: FAO, 1 July – 30 June

### (a) Nitrogen fertilizers

9. Demand for nitrogen fertilizers continues to be high in Asia, which, according to a report by the FAO<sup>3</sup>, could account for 69% of future growth in world demand. North America accounts for 14% of the increase in demand and Latin America for 7%. The other regions (Africa, Eastern Europe and Oceania) each account for some 2% to 3% of the increase in demand for nitrogen fertilizers. Table 3 shows the situation of supply and demand for nitrogen fertilizers.

<sup>1</sup> FAO, 'Current world fertilizer trends and outlook to 2011/12', Rome, 2008.

<sup>2</sup> Situation in 2007/08 and projections from 2008/09 to 2011/12.

<sup>3</sup> FAO, 'Current world fertilizer trends and outlook to 2011/12', Rome, 2008.

**Table 3: World nitrogen supply and demand balance<sup>4</sup>**

	2007/08	2008/09	2009/10	2010/11	2011/12
Total supply	131 106	136 252	140 732	147 748	154 199
Total demand	127 820	130 409	133 059	136 198	139 140
Surplus/(deficit)	3 286	5 843	7 673	11 550	15 059

In thousand tonnes

Source: FAO, 1 July – 30 June

**(b) Potash fertilizers**

10. As indicated in Table 1 above, world demand for potash fertilizers is expected to increase by 2.4% per year. Once again, Asia is the main contributor of this increase as its share represents around 68% of the world total growth compared to 26% for America. It is expected that supply will continue to exceed demand as prices remain firm. Table 4 presents the supply and demand situation.

**Table 4: World potash supply and demand balance<sup>5</sup>**

	2007/08	2008/09	2009/10	2010/11	2011/12
Total supply	38 325	37 512	39 526	41 474	43 213
Total demand	32 571	33 519	34 432	35 505	36 453
Surplus/(deficit)	5 754	3 993	5 094	5 970	6 760

In thousand tonnes

Source: FAO, 1 July – 30 June

**(c) Phosphate fertilizers**

11. Demand for phosphate fertilizers will increase by around 2% per year from 2007/08 to 2011/12 according to the FAO. Asia is the main contributor to this increase in demand representing more than 71% followed by America (21%). African share in this increase in demand is marginal. The surplus of supply over demand, which was 387,000 tonnes in 2007/08 is expected to increase (Table 5).

**Table 5: World phosphate supply and demand balance<sup>6</sup>**

	2007/08	2008/09	2009/10	2010/11	2011/12
Total supply	37 000	38 461	39 672	41 112	43 299
Total demand	36 613	37 554	38 456	39 528	40 426
Surplus/(deficit)	387	907	1 216	1 584	2 873

In thousand tonnes

Source: FAO, 1 July – 30 June

<sup>4</sup> Situation in 2007/08 and projections from 2008/09 to 2011/12.

<sup>5</sup> Situation in 2007/08 and projections from 2008/09 to 2011/12.

<sup>6</sup> Situation in 2007/08 and projections from 2008/09 to 2011/12.

## II. PRICES OF FERTILIZERS USED IN COFFEE FARMING

### II.1 Price trends

12. Table 6 shows price indexes for fertilizers and petroleum products and the ICO composite indicator price.

**Table 6: Prices of fertilizers and petroleum products and ICO composite indicator price**  
Index 2000 = 100

Year/Month	Urea	Potash	Phosphate	Spot Petroleum	Natural Gas	ICO composite
1990	129.32	80.11	92.47	81.52		111.35
1991	149.31	88.86	97.03	68.69	33.68	103.99
1992	122.15	91.49	95.32	67.52	40.65	83.05
1993	93.37	87.69	75.34	59.54	49.08	95.94
1994	129.96	86.30	75.34	56.56	44.46	209.29
1995	185.16	96.13	79.91	60.99	39.57	215.47
1996	177.05	95.45	89.04	72.23	62.44	158.89
1997	112.76	95.45	93.22	68.33	57.12	208.45
1998	82.20	95.42	98.17	46.35	48.47	169.60
1999	65.68	99.30	100.46	64.33	52.49	133.42
2000	100.00	100.00	100.00	100.00	100.00	100.00
2001	94.26	96.41	95.43	86.17	91.91	70.97
2002	93.37	92.49	93.61	88.65	78.02	74.32
2003	137.39	92.49	92.47	102.48	127.57	80.79
2004	173.39	101.71	93.61	134.04	137.16	96.75
2005	216.62	129.14	95.89	189.36	205.71	139.10
2006	220.57	142.45	100.91	228.01	156.51	149.05
2007	306.03	163.27	161.87	252.13	161.93	167.62
2008*	511.42	450.38	788.11	362.02	198.58	193.42
Jan	365.68	222.86	433.79	321.99	185.34	190.43
Feb	321.76	314.29	433.79	332.62	127.94	216.10
Mar	373.69	363.27	737.67	360.99	140.90	211.97
Apr	466.17	389.88	839.04	386.88	217.00	197.00
May	620.67	423.10	839.04	435.46	261.56	197.32
Jun	621.56	438.78	839.04	466.31	294.45	203.16
Jul	751.73	457.14	839.04	470.21	257.43	206.69
Aug	761.62	522.45	981.74	406.38	191.59	204.14
Sep	698.62	575.51	981.74	352.13	176.95	197.21
Oct	401.09	622.45	945.21	257.80	156.38	168.60
Nov	243.13	624.49	799.09	191.49	155.48	167.93

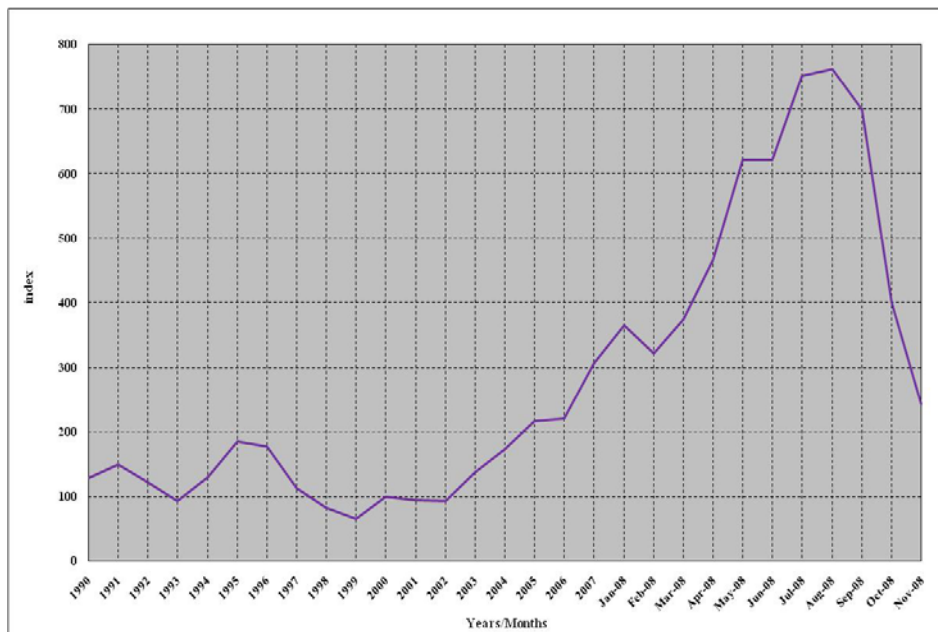
\*January to November

Sources: IMF, International Financial Statistics  
International Coffee Organization

**(a) Urea prices**

13. Urea prices have increased steadily since the end of 2002. This increase became more marked, however, in recent months, when the annual average price went up from US\$309.4 per tonne in 2007 to US\$517 per tonne in 2008. Prices reached US\$770 per tonne in August 2008 before falling steadily during the remainder of the year (Table 6). Graph 1 shows the price index for urea from 1990 onwards.

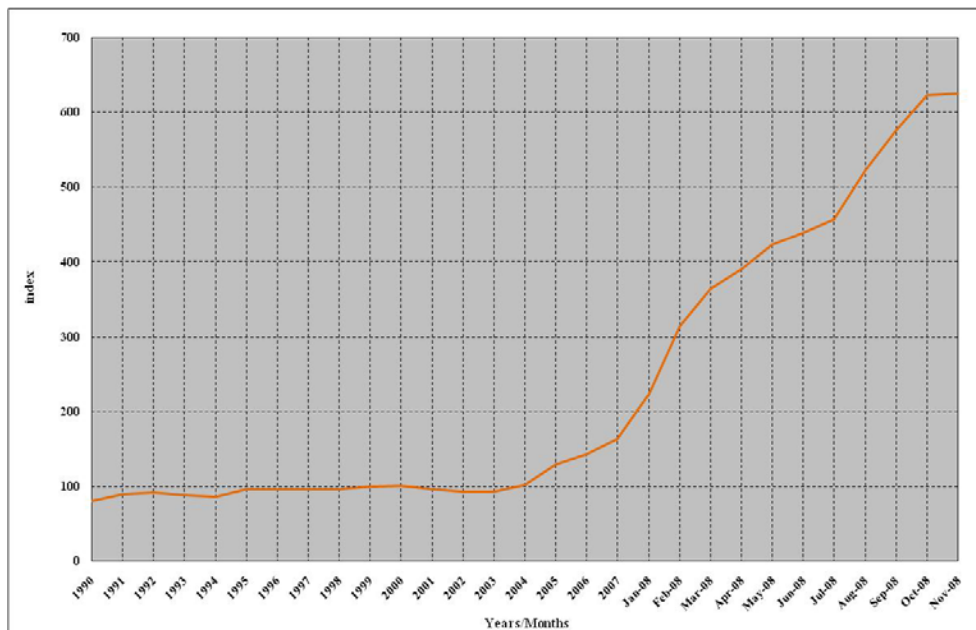
**Graph 1: Index of urea prices  
2000 = 100  
Calendar years 1990 - 2007  
Monthly January - November 2008**



**(b) Potash prices**

14. The price of potash began to go up in 2004 and has escalated in recent months, rising from an average of US\$200 per tonne in 2007 to more than US\$551 per tonne in 2008, an increase of 176%. In monthly terms, prices have recorded a continued increase between January 2008 and November 2008 (Table 6). Graph 2 shows changes in potash prices since 1990.

**Graph 2: Index of potash prices  
2000 = 100  
Calendar years 1990 - 2007  
Monthly January - November 2008**

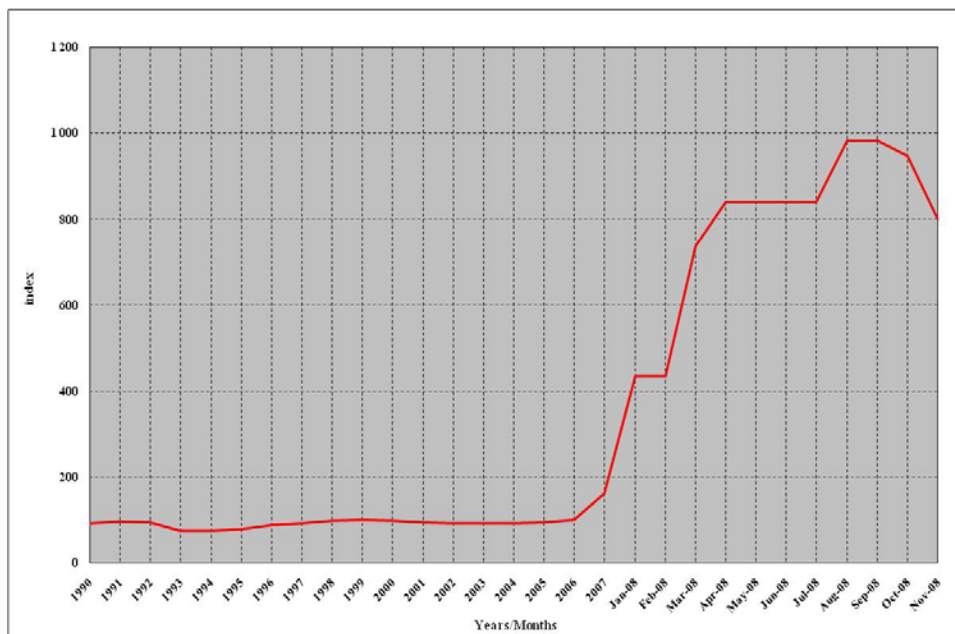




**(c) Phosphate prices**

15. Phosphate prices have recently increased by 387%, rising from US\$70.9 per tonne in 2007 to US\$345.2 per tonne in 2008 (Table 6). Prices reached the level of US\$430 per tonne in August and September 2008 before falling back to US\$350 in November 2008. Graph 3 shows price indexes of phosphate fertilizers since 1990.

**Graph 3: Index of phosphate prices  
2000 = 100  
Calendar years 1990 - 2007  
Monthly January - November 2008**



**(d) Correlations with petroleum, natural gas and coffee**

16. Table 7 shows the correlation coefficients between the prices of fertilizers, petroleum, natural gas and the ICO composite indicator. Strong positive correlations exist between the price of petroleum and urea (0.91), potash (0.85) and phosphate (0.76), respectively. Positive, albeit not as high, correlations are also registered between the prices of natural gas and fertilizers: 0.70 for urea, 0.61 for potash and 0.50 for phosphate. On the other hand, correlations between the price of coffee, represented by the ICO composite indicator, and fertilizers are positive but relatively low: 0.41 for urea, 0.33 for potash and 0.29 for phosphate.

**Table 7: Correlation coefficients between the annual prices of fertilizers, petroleum, natural gas and the ICO composite indicator**

<b>Correlation</b>	<b>Urea</b>	<b>Potash</b>	<b>Phosphate</b>	<b>Petroleum</b>	<b>Natural Gas</b>	<b>ICO composite</b>
Urea	1.00	0.91	0.85	0.91	0.70	0.41
Potash		1.00	0.98	0.85	0.61	0.33
Phosphate			1.00	0.76	0.50	0.29
Petroleum				1.00	0.88	0.22
Natural Gas					1.00	0.01
ICO Composite						1.00

## **II.2 Underlying factors affecting fertilizer prices**

### **(a) Factors affecting demand for fertilizers**

17. Increase in international demand for fertilizers played a major role in their dramatic price rise. In the case of nitrogen fertilizers demand increased by nearly 14% between 2001 and 2007, for phosphates it increased by more than 13% and for potash by 10%. Agriculture needs fertile soils to ensure the maintenance of optimal conditions for the productivity required to meet the nutrition needs of a constantly growing world population. In these circumstances, fertilizers are needed to create conditions for efficient farming. There are a number of factors accounting for the increasing demand for fertilizers, including: economic and population growth, economic policies, the development of alternative energy sources and loss of agricultural land.

#### *World economic growth*

18. World economic growth is a major factor in the increased demand for food, which requires an intensification of agricultural production. With the improvement in the income levels of populations in emerging countries there has not only been an increase in demand for food but a change in eating habits. In order to maintain food self-sufficiency, these emerging countries require fertilizers to increase their agricultural production, particularly cereal production. The strongest demand for fertilizers comes from Asia, more specifically China and India. China is the world's biggest consumer of potash.

#### *Population growth*

19. World population is constantly increasing while arable land is diminishing. Developing countries are experiencing strong population growth. Some of these countries have opted for an intensification of agriculture in order to feed this growing population, while others, which continue to practice extensive agriculture, are constantly threatened with food shortages. China, which has the world's lowest ratio of arable land per capita, has been under

enormous pressure to increase its fertilizer use in order to raise food production for its population. Fertilizer consumption increased from 2.6 million tonnes in 1965 to almost 36 million tonnes in 1997, with cereal production increasing from 167 million to 447 million tonnes.

#### *Loss of arable land*

20. The steady shrinkage of arable land forces populations to intensify agriculture in order to increase productivity and reduce production costs. In the 1950s there was around 0.5 hectares of arable land per capita; by 1990, this ratio had decreased to 0.3 hectares. Some projections indicate figures of between 0.1 and 0.2 hectares of arable land per capita in 2050.

#### *Economic and fiscal policies*

21. Demand for fertilizers is also influenced by the economic policies applied by countries through agricultural subsidies or fiscal policies. In other words, the existence of financial incentives for farmers can influence demand for fertilizers. Governments can offer their farmers a technological package that includes extension services supported by appropriate agricultural research, availability of agricultural inputs, improved market access, and access to financing. Exchange rate policies can also influence demand for fertilizers, particularly fertilizer imports.

#### *Development of alternative energy sources*

22. The development of biofuels has put pressure on demand for cereals, particularly maize. This development was encouraged by the need to reduce dependence on petroleum products and the necessity of promoting environmental protection. There was a dramatic increase in the demand for agricultural products like maize, sugar, soy, palm oil, rapeseed and wheat, requiring intense use of fertilizers in order to meet this demand.

#### **(b) Factors affecting fertilizer supply**

23. A number of factors affect the supply of fertilizers and can influence their price formation. The main factors are production capacity, production costs and transport and logistics.

#### *Production capacity*

24. The most important factor is fertilizer extraction or production capacity. Production capacity makes it possible to predict medium- and long-term availability of fertilizers. In the case of potash, Canada has the biggest production capacity with numerous potassium mines. The Russian Federation and Belarus also have significant production capacities. In the case of

phosphates, large mines exist in Brazil, China, India, the Russian Federation and the United States. As for nitrogen fertilizers, projected supply capacities exceed demand. Current price levels have led to an increase in a number of production programmes, as factors of production have improved in many producing countries. In addition, a number of companies that had previously reduced production due to the high prices of natural gas are now encouraged to resume their production activities.

#### *Production and distribution costs*

25. Production costs, particularly the high cost of the capital needed to exploit potassium and phosphate mines, can influence supply availability. Conditions affecting the supply of raw materials used in the manufacture of fertilizers are a major influence. These raw materials are hydrocarbons, particularly natural gas used as the source of energy in the manufacture of ammonia and hence nitrogen. In many countries, manufacture of ammonia has benefited from the availability of gas at attractive prices. In other words, fertilizer production costs are a determining factor in supply and price.

#### *Transport and logistics*

26. Maritime freight has become increasingly important in the fertilizer trade, particularly in the case of potash, for which 80% of global production enters world trade. Since potash is the world's most widely traded fertilizer, its price is significantly affected by developments in maritime freight charges. In the case of nitrogen and phosphate fertilizers, this factor is less significant since a smaller share of production enters world trade.

### **III. IMPACT OF FERTILIZER PRICE CHANGES ON COFFEE PRODUCTION**

27. The increase in fertilizer prices threatens to undermine the efforts of coffee exporting countries to increase and maintain their productivity. However, the impact in specific cases will depend on the intensity of fertilizer use in coffee farming and a country's dependence on fertilizer imports. In other words, the impact of fertilizer price increases in coffee exporting countries can be measured in terms of the production cost structure. In this regard, note should be taken that this study considers only the costs of fertilizers and does not take into account expenditures related to crop protection products, which also comprise a significant share of production costs in many coffee producing countries and exhibit similar price behaviour to fertilizers. Coffee exporting countries that are among the world's biggest consumers of fertilizers are India and Brazil.

### **III.1 Africa**

28. Fertilizer use in Africa is limited, accounting for only 1% of world consumption. Only about 10 countries out of a total of 58 use fertilizers in farming. The region's main fertilizer users (Egypt, South Africa and Morocco) are not coffee producing countries. Some coffee exporting countries, such as Kenya, Tanzania, Ethiopia, and Côte d'Ivoire, use fertilizers in coffee farming on a relatively modest scale compared to the situation in other producing regions.

### **III.2 Latin America**

29. The main users of fertilizers in this region are Brazil and Mexico, which respectively account for 60% and 12% of the region's total consumption. In Brazil, demand for fertilizers is constantly increasing as a result of the development of cereal crops and sugar cane for use in biofuels. Brazil imports around 85% of its potash consumption, the main fertilizer used in coffee farming. With potash prices continuing to rise, coffee production costs are bound to increase if the country maintains its intensive use of this product.

30. A survey conducted by CONAB, the government agency responsible for agricultural estimates in Brazil, of production costs for the 2008/09 crop shows wide variations by region. For Arabica growers, the share of fertilizers in total costs varies between 16.2% and 23.2%, with the exception of the state of Bahia, where many plantations are highly technified and a share of 32.2% is recorded. In the case of Robusta, fertilizers account for 13.8% of costs in Espírito Santo, the largest Robusta producing state. Farmers in Rondônia, the other major Robusta producing state, are recorded as not making any use of fertilizers.

31. In Colombia, data provided by the National Federation of Coffee Growers indicate that fertilizers accounted for 23.7% of production costs in 2008.

32. In Costa Rica, fertilizers were estimated by the Coffee Institute of Costa Rica to comprise 12.3% of total production costs in 2007/08.

### **III.3 Asia and Oceania**

33. Among the region's coffee exporting countries, India is the biggest fertilizer consumer, followed by Vietnam and Indonesia. India is also a significant fertilizer producer. Vietnam's fertilizer requirements were estimated at 7.9 million tonnes in 2007. As the country imports a little over half of its fertilizer consumption, the rise in fertilizer prices entails an increase in production costs. According to information compiled by Vinacafé for 2007, fertilizers accounted for 14.2% of Robusta coffee production costs.

#### IV. CONCLUSION

34. The production of food, particularly cereals, has been the main driving force for the fertilizer industry in recent years. In turn, food production is largely a function of population growth. Fertilizer consumption is increasing in many countries, particularly in Asia, where the need to ensure food self-sufficiency is at the heart of government concerns. Since the fertilizers needed for food crops are the same as those used in coffee farming, the escalation of their prices has a negative impact on the profitability of coffee producers.

35. Furthermore, the dwindling of arable land will maintain pressure on demand for fertilizers used to ensure improved yields. With the development of biofuels, the need to intensify agriculture will increase this pressure on demand, and only an increase in supply could cushion the impact on prices. Nevertheless, concerns regarding protection of the environment could lead to greater use of organic fertilizers or the use of chemical fertilizers in optimal conditions in regard to water and environmental pollution.

36. The current downturn in fertilizer prices, following the commodity boom registered in the first half of 2008, reflects the generalized sell-off of assets in the wake of the global economic crisis. It is also influenced by an increase in production capacity and the improvement of production factors to respond to recent increases in demand. In the longer term, the recent drop in petroleum and natural gas prices and the improvement of production factors in many producing countries are likely to contribute to a reduction in the production costs of fertilizers, thus stimulating an increase in supply.

37. More specifically, the surpluses of phosphate and nitrogen will increase while those of potash are likely to remain stable as demand for food crop production will continue to increase with the development of biofuels. At a regional level, countries in Asia will continue to be net importers of nitrogen and potash fertilizers while exporting their surplus of nitrogen. Countries in America are expected to be net importers of nitrogen, but will reduce their deficit in phosphate production compared to their needs and will continue to be the main supply source of potash fertilizers. Europe will continue to be the major exporter of nitrogen and potash as well as maintaining its surplus of phosphates. Although Africa is a marginal consumer of fertilizers, it remains an important exporter of phosphate.

38. Overall, the factors underlying the recent rise in demand for fertilizers are expected to manifest themselves again when the world starts to recover from the current economic turbulence. However, increases in the supply of the three fertilizers are expected to be sufficient to meet such demand.