



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

World Fertilizer Model—The WorldNPK Model

Francisco Rosas

Working Paper 11-WP 520

April 2011

**Center for Agricultural and Rural Development
Iowa State University
Ames, Iowa 50011-1070
www.card.iastate.edu**

Francisco Rosas is a PhD candidate and research assistant in the Department of Economics and Center for Agricultural and Rural Development at Iowa State University.

Acknowledgments: The author thanks the David and Lucile Packard Foundation and the Biobased Industry Center (BIC) at Iowa State University for project funding.

This paper is available online on the CARD Web site: www.card.iastate.edu. Permission is granted to excerpt or quote this information with appropriate attribution to the authors.

Questions or comments about the contents of this paper should be directed to Francisco Rosas, 573 Heady Hall, Iowa State University, Ames, IA 50010; Ph.: (515) 294-6357; E-mail: frosas@iastate.edu.

Iowa State University does not discriminate on the basis of race, color, age, religion, national origin, sexual orientation, gender identity, genetic information, sex, marital status, disability, or status as a U.S. veteran. Inquiries can be directed to the Director of Equal Opportunity and Compliance, 3280 Beardshear Hall, (515) 294-7612."

Abstract

We introduce a world fertilizers model that is capable of producing fertilizer demand projections by crop, by country, by macronutrients, and by year. For each crop, the most relevant countries in terms of production, consumption, or trade are explicitly modeled. The remaining countries are modeled, for each crop, within a regional aggregate. The nutrient coverage includes nitrogen (N), phosphorous (P), and potassium (K). In this report we present the data and procedures used to set up the model as well as the assumptions made. The fertilizer model interacts with the yield equations of the FAPRI-ISU model (Food and Agricultural Policy Research Institute at Iowa State University), and by means of a set of production elasticities, projects each nutrient's application rate per hectare for each commodity and each country covered by the FAPRI-ISU model. Then, the application rates and the areas projected by FAPRI-ISU are used to obtain projections of fertilizer demand from agriculture on a global scale. With this fertilizer module, policies that directly affect fertilizer markets, such as input taxes or subsidies, quantity use restrictions, and trade restrictions, can now be explicitly formulated and evaluated. The effects of these policies on global agricultural markets and on greenhouse gas emissions can be evaluated with the FAPRI-ISU model and the Greenhouse Gas in Agriculture Simulation Model (GreenAgSiM). Also, any other policy affecting commodity markets such as input and output price shocks, biofuels mandates, and land-use change can now be evaluated with regard to its impacts on the world fertilizer markets.

Keywords: agriculture, fertilizer, nitrogen, phosphorous, policy analysis, potassium, projections.

JEL codes: Q10, Q11, Q18

Introduction

The rising demand for agricultural commodities in order to satisfy demand for food, feed, and fuel has increased interest in the supply side of agricultural commodity markets. Extended periods of growth in developing countries have driven up the demand for food and feed. Also, recent policies that encourage the use of biofuels have resulted in an increased demand for agricultural commodities. These changes in global commodity markets have several environmental consequences that have also been in the center of attention in the international community.

Fertilizers play an important role in the recent changes in global agricultural commodity markets. Fertilizer use is directly connected to the forces driving crop supply through the increase in productivity. The use of fertilizers in agriculture also has direct and indirect consequences for the environment. For these reasons, it is important to understand how fertilizers respond to changes in the global economy and how fertilizers interact with the crops for which they are used.

We have developed a world fertilizer model, the WorldNPK model, that by interacting with a broader model of international commodity markets supplied by the Food and Agricultural Policy Research Institute at Iowa State University—the FAPRI-ISU model—allows us to determine and project the use of fertilizers in agriculture. The WorldNPK model covers three macronutrients individually: nitrogen (N), phosphorous (P), and potassium (K); 15 crops; and the most relevant countries and regions for each commodity in terms of production, consumption, or trade.

The objective of this report is to describe the procedures used to set up the world fertilizer model (WorldNPK), as well as to discuss the assumptions made in the model. We also explain the planned extensions and improvements. The construction of the fertilizer model is divided into two stages.

First Stage. The model projects the quantities of N, P, and K demanded for each crop and for each country/region covered by the FAPRI-ISU model. Demand for each nutrient is obtained by projecting a fertilizer application rate that is crop-specific and country-specific as a function of the relevant variables affecting the farmer's fertilization decision. Then, we use the crop areas projected by FAPRI together with the nutrient application rates to obtain a crop- and country-specific quantity demanded for each N, P, and K.

Second Stage. The output of the model will be projections of crop- and country-specific nutrient (N, P, and K) quantities demanded as described in the first stage, and projections of world fertilizer prices at the nutrient level, such that they are consistent with a zero excess demand in each nutrient world market. We do this by introducing a nutrient-specific world supply curve and solve for an endogenous fertilizer price of equilibrium that clears the mentioned market.

The WorldNPK Model: A Demand Model

The FAPRI-ISU model covers supply, demand, and international trade of 15 crops worldwide. The crops are wheat, corn, rice, barley, oats, sorghum, rye, soybeans, canola, rapeseed, sunflower seed, oil palm,

cotton, sugarcane, and sugar beet. Either individually or within a region, every country in the world is covered in the FAPRI model. In terms of crop production, FAPRI reports projections of harvested areas (AHH) and yields (YHH) for each country/region, among other relevant variables.

The objective of the fertilizer model is to provide projections of quantities of fertilizer demanded that are nutrient/crop/country-specific. Each quantity demanded is obtained as the product of a fertilizer application rate (in kilograms per hectare) and a harvested area (in hectares).¹ Our procedure is as follows. We first generate a fertilizer application rate per nutrient, crop, and country for selected base years (2006/07 and 2007/08). Second, we collect and construct fertilizer prices for each nutrient at the country level. Then, we incorporate these fertilizer rates and prices into the existing FAPRI-ISU model as part of the variable cost of production in each crop yield equation of the model. When the FAPRI model runs, the fertilizer rate reacts to changes in the relevant variables of the fertilizer decision process, conditional on the parameters of the model. It also projects each fertilizer rate for future years according to the dynamics embedded in the model. Finally, we multiply these fertilizer rates by the harvested areas projected by FAPRI, in order to obtain the desired quantities demanded of fertilizer by nutrient, by crop, and by country.

In the rest of the report, we describe (1) how we obtain these fertilizer rates for the base years (i.e., an accounting model of fertilizer demand), and (2) how the interaction is implemented in a way that is not only consistent with the rest of the FAPRI-ISU model but is also consistent with the economics of fertilizer use in agriculture.

The major benefits of developing this world fertilizer model are improving the existing FAPRI model as a consequence of the specific treatment of fertilizers used in agriculture, and responding to the general interest in fertilizer application rates and fertilizer demand projections at the nutrient, country, and crop levels.

The Accounting Model

We obtained an application rate for each nutrient, N, P, and K, that is crop and country specific. We used, in order of importance, the following data sources.

1. "Assessment of Fertilizer Use by Crop at the Global Level 2006/07 – 2007/08," Patrick Heffer, International Fertilizer Industry Association, April 2009 (hereafter IFA 2009)
2. "Fertilizers Europe data base on nutrient application rate by crop". Fertilizers Europe 2010
3. "Fertilizer Use by Crop". FAO 2006 (hereafter FAO 2006)
4. "Fertilizer Use by Crop". FAO 2002 (hereafter FAO 2002)
5. "Fertilizer Use by Crop for Specific Countries" FAO 2002-2005 (hereafter FAO 2002-2005)
6. "Agricultural Census" Ministry of Agriculture - Government of India 1986, 1991, 1996, and 2001

The IFA 2009 report provides the worldwide fertilizer consumption of the 23 bigger fertilizer consumer countries and the rest of the world (ROW). For each country it provides the demand (by nutrient) for each of the following crops: wheat, corn, rice, other cereals, soybeans, oil palm, other oilseeds, cotton, sugar

¹ Note that throughout the model we use the term fertilizer application rate to refer to the more appropriate term, fertilizer use per harvested hectare.

crops, fruits and vegetables, and other crops. The years covered are the campaigns 2006/07 and 2007/08. We made extensive use of these statistics because they span the world, and to our knowledge this is the most updated report. Appendix A shows this dataset.

The FAO 2006 report provides statistics on fertilizer use by nutrient and for several countries, and in some cases summarizes information provided in the “Fertilizer Use by Crop” for specific countries’ reports (FAO 2002-2005). The FAO 2002 study provides area, fertilizer rates, percentage of fertilized area, and fertilizer consumption by nutrients and by crop for 88 countries and for their most important crops. While this report covers most of the countries and crops of interest, data are from 1996 to 2000. Finally, the “Fertilizer Use by Crop” for specific countries contains detailed expositions of the cropping systems, fertilizer industry, and fertilizer use of the corresponding country, but it usually provides data that can be found in the previous reports.

The crop- and country-specific nutrient application rates for the base years were obtained in three steps. Results are shown in Appendix B for each nutrient and for the base year 2007/08.

First, we directly associated each of the 23 higher fertilizer consuming countries from IFA 2009 with the FAPRI countries for the following crops: wheat, corn, rice, soybeans, oil palm, and cotton. When a country in IFA 2009 was not individually reported by FAPRI, it was added to the ROW, for example, Chile or Iran in wheat. Depending on the crop, these 23 countries accounted for about 90% of the world fertilizer demand of that crop.

Second, and for the same crops, we allocated what was reported as ROW by IFA 2009 to each of the remaining countries or regions in the FAPRI model. While this allocation accounts for about 10% of the world fertilizer demand, a significant amount of effort was put into finding the most appropriate fertilizer rate for each country. The allocation was done one crop at a time and required finding the most updated fertilizer application rate, collected from different sources. We first found a fertilizer rate for the highest producing countries of that particular crop; then, the remaining countries were assumed to lie on the same production function, and a fertilizer rate was calculated for each of them, such that those with lower yields were assumed to have a lower rate, and those with higher yields were assumed to have a higher rate.

Third, once we completed these crops, we turned to the nutrient demands of “Other Coarse Grains,” “Other Oilseeds,” and “Sugar” reported in IFA 2009 that had to be distributed into the remaining crops in the FAPRI-ISU model (barley, sorghum, oats and rye; rapeseed/canola, peanut and sunflower seed, sugar beet, and sugarcane). Note that the categories “Other Coarse Grains” and “Other Oilseeds” in the IFA 2009 report include some crops not covered by FAPRI, such as triticale, millet, mustard, and copra. While FAPRI does not project the harvested areas of these crops, their demand will be taken into account in the barley, sorghum, oats, rye, canola, peanut, rapeseed, and sunflower seed commodities because their rates will be slightly overestimated. In the case of “Other Coarse Grains,” we took one country at a time and distributed the fertilizer demand from IFA 2009 into the four cereals (barley, sorghum, oats, and rye) covered by FAPRI. If FAPRI covered only one cereal for a certain country, all the demand was assigned to that crop. If there was more than one cereal, the demand was distributed proportional to the fertilizer rates from the most reliable source (FAO 2006, FAO 2002, or FAO 2002-2005). Similarly, we distributed the fertilizer demand of “Other Oilseeds” from IFA 2009 among rapeseed/canola, peanut, and sunflower

seed for the countries covered by FAPRI. We used the same procedure for the IFA 2009 fertilizer demand of “Sugar” that we distributed among sugar beet and sugarcane.

Demonstration of Procedures

We present in this section the cases of China, India, EU-27, and Ukraine to illustrate the procedures used. The first three, shown in Table 1, will help demonstrate the procedure used when IFA reported the crop-specific fertilizer demand for a given country, as these three countries represent more than 50% of the world fertilizer consumption (IFA 2009). Ukraine was chosen to illustrate the methodology used for the cases when FAPRI reports a country that was not individually reported by IFA 2009.

Table 1 shows how fertilizer use by nutrients is reported by IFA. In the cases of wheat, rice, corn, soybeans, and cotton, we took the harvested area from FAPRI and directly obtained the fertilizer application rate for each nutrient.

Table 1. Fertilizer use by crop in 2006/07 in China, India, and EU-27, extracted from the IFA 2009 report

| | | CEREALS | | | | | | | | | | OILSEEDS | | | | | Cotton | | Sugar Crops | | Fruits & Veg. | | Other Crops | | |
|-------|-------------------------------|------------|-------|-------|-------|-------|-------|-------|-------|----------|-------|----------|-----|----------|----|----------|--------|------|-------------|-------|---------------|-------|-------------|-------|-------|
| | | Total | | Wheat | | Rice | | Maize | | Other CG | | Soybean | | Oil Palm | | Other OS | | % | Qty | % | Qty | % | Qty | % | Qty |
| | | % of World | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | |
| China | N | 30,200 | 31.5% | 14.1% | 4,258 | 18.2% | 5,496 | 16.1% | 4,862 | 1.0% | 302 | 1.5% | 453 | 0.0% | 6 | 4.8% | 1,450 | 4.1% | 1,238 | 1.5% | 453 | 30.0% | 9,060 | 8.7% | 2,621 |
| | P ₂ O ₅ | 11,600 | 30.3% | 16.5% | 1,914 | 15.3% | 1,775 | 6.6% | 766 | 1.0% | 116 | 3.3% | 383 | 0.0% | 2 | 5.0% | 580 | 3.9% | 452 | 2.2% | 255 | 34.0% | 3,944 | 12.2% | 1,413 |
| | K ₂ O | 5,800 | 21.4% | 4.4% | 255 | 28.0% | 1,624 | 2.2% | 128 | 1.0% | 58 | 1.0% | 58 | 0.1% | 6 | 2.3% | 133 | 1.2% | 70 | 4.8% | 278 | 50.0% | 2,900 | 5.0% | 290 |
| | N+P+K | 47,600 | 29.5% | 13.5% | 6,427 | 18.7% | 8,895 | 12.1% | 5,755 | 1.0% | 476 | 1.9% | 894 | 0.0% | 14 | 4.5% | 2,163 | 3.7% | 1,760 | 2.1% | 987 | 33.4% | 15,904 | 9.1% | 4,325 |
| India | N | 13,773 | 14.4% | 21.0% | 2,892 | 30.0% | 4,132 | 2.5% | 344 | 4.5% | 620 | 1.0% | 138 | 0.0% | 0 | 4.5% | 620 | 6.5% | 895 | 5.0% | 689 | 7.0% | 964 | 18.0% | 2,479 |
| | P ₂ O ₅ | 5,543 | 14.5% | 20.0% | 1,109 | 25.0% | 1,386 | 1.5% | 83 | 5.0% | 277 | 2.5% | 139 | 0.0% | 0 | 7.0% | 388 | 8.0% | 443 | 4.5% | 249 | 11.0% | 610 | 15.5% | 859 |
| | K ₂ O | 2,335 | 8.6% | 8.0% | 187 | 34.0% | 794 | 1.0% | 23 | 2.5% | 58 | 1.0% | 23 | 0.0% | 0 | 5.0% | 117 | 5.5% | 128 | 10.0% | 234 | 22.0% | 514 | 11.0% | 257 |
| | N+P+K | 21,651 | 13.4% | 19.3% | 4,188 | 29.2% | 6,312 | 2.1% | 451 | 4.4% | 955 | 1.4% | 300 | 0.0% | 0 | 5.2% | 1,125 | 6.8% | 1,467 | 5.4% | 1,172 | 9.6% | 2,088 | 16.6% | 3,595 |
| EU-27 | N | 10,746 | 11.2% | 26.0% | 2,794 | 0.4% | 43 | 12.0% | 1,290 | 16.0% | 1,719 | 0.1% | 11 | 0.0% | 0 | 9.2% | 989 | 0.5% | 54 | 2.1% | 226 | 7.5% | 806 | 26.2% | 2,815 |
| | P ₂ O ₅ | 3,091 | 8.1% | 19.5% | 603 | 0.5% | 15 | 13.2% | 408 | 15.9% | 491 | 0.3% | 9 | 0.0% | 0 | 8.2% | 253 | 0.7% | 22 | 3.6% | 111 | 13.4% | 414 | 24.7% | 763 |
| | K ₂ O | 3,592 | 13.2% | 12.7% | 456 | 0.9% | 32 | 11.9% | 427 | 12.8% | 460 | 0.3% | 11 | 0.0% | 0 | 9.9% | 356 | 0.6% | 22 | 5.9% | 212 | 14.4% | 517 | 30.6% | 1,099 |
| | N+P+K | 17,429 | 10.8% | 22.1% | 3,853 | 0.5% | 91 | 12.2% | 2,125 | 15.3% | 2,671 | 0.2% | 31 | 0.0% | 0 | 9.2% | 1,598 | 0.6% | 97 | 3.1% | 549 | 10.0% | 1,737 | 26.8% | 4,678 |

Then, according to the IFA 2009 report, “Other Coarse Grains” includes barley, oats, rye, sorghum, triticale, millet, etc. So, for example, we needed to allocate among these crops China’s demand of 302,000 tons of nitrogen and the EU-27’s 1,719,000 tons of nitrogen. We distributed this quantity only among those crops covered by FAPRI (barley, oats, rye, and sorghum) and ignored the other crops not covered because we would not be able to give projections of fertilizer demand. While this will overestimate their crop-specific fertilizer demand, it will be closer at the nutrient’s aggregate level. To make this allocation, we found the N, P, and K rates in China, India, and EU-27 for each of the four crops from the most reliable source and proportionally distributed each total nutrient demand. In China, barley is the only relevant crop among these according to FAPRI, so we directly calculated the N rate as the ratio between the 302,000 tons and the FAPRI harvested area. For the case of Europe, our most reliable source is “Fertilizers Europe” (2010), which reports fertilizer application rates by nutrients for all crops in 2007/08. Given that FAPRI reports harvested areas of barley, oats, and rye in the EU-27, a fertilizer application rate was found for each crop such that it maintains the relationship between rates given by Fertilizers Europe 2010, and when multiplied by the areas from the FAPRI-ISU model it gives a total demand of 1,719,000 tons of N, 491,000 tons of P, and 460,000 of K. The assumption that the proportionality of fertilizer rates between crops remains constant implies that there was no structural change in the cropping system that affected only one of these crops; if there was any, it affected all of them equally.

The same criterion was used to allocate each country's fertilizer demand of "Other Oilseeds" from IFA 2009 into rapeseed, peanuts, and sunflower (others such as mustard and safflower were not considered because they are not projected by FAPRI). For example, the 1,450,000 tons of N in China were distributed among rapeseed, peanuts, and sunflower in a way consistent with the fertilizer application rates from FAO 2002, such that when the FAPRI harvested areas were multiplied by the calculated fertilizer rates, they add up to the 1,450,000 tons of N while maintaining the distance between the rates of each crop from FAO 2002. The same was done for the 580,000 and 133,000 tons of P and K, respectively. For the case of India, the fertilizer demand was distributed among peanuts and rapeseed, also using the rates from FAO 2002, while for EU-27 the fertilizer demand was distributed among rapeseed and sunflower using the rates from Fertilizers Europe 2010.

Then "Sugar Crops," composed only of sugarcane and sugar beet, were distributed according to the methodology described above and using the FAO 2002 report for the rates of China and India. The Fertilizers Europe 2010 report does not give rates for sugarcane, but according to FAPRI most of the area is devoted to sugar beet (99.98%), so the sugarcane fertilization rate from another developed country (Australia) was used to calculate the fertilizer demand attributed to sugarcane, and the rest was allocated to sugar beet (and its corresponding rates were obtained).

Finally, FAPRI does not report harvested areas for the categories of "Fruits and Vegetables" (FV) and "Other Crops" (OC—roots and tubers, pulses, nuts, rubber, coffee, tea, tobacco, ornamentals, turf, pastures, forestry) from IFA 2009. However, they account for about 30% of the world fertilizer demand. In order to project an aggregated world nutrient demand of FV and OC, we assumed that world N, P, and K demand for FV and OC changes at the same rate as the world nutrient demand of all the remaining crops. So, for example, once we calculated the total demand of N for each crop and country reported by FAPRI, we obtained its rate of change with respect to the previous year and applied it to the demand of FV and OC. The same was done for P and K. Note that this demand projection is not country specific.

The last step was to allocate, to all the remaining countries or regions for which FAPRI gives a harvested area and yield projection, the fertilizer demand reported by IFA 2009 as ROW. Also, when for a given crop there were countries reported by IFA 2009 but not reported individually by FAPRI, that nutrient demand was added to the ROW. Given that the FAPRI model's coverage of countries is bigger than that of the IFA 2009 report, this had to be done for several countries or regions.

As an illustrating example, we describe in detail how we obtained each N, P, and K application rate for Ukraine that is not individually reported by IFA 2009 but is individually reported by FAPRI as a producer of several crops (wheat, corn, sugar beet, rapeseed, sunflower, barley, oats, and rye). We could not find fertilizer application rates for Ukraine, other than some fertilizer recommended rates (FAO-FUBC-Ukraine 2005), which are far from the actual rates according to the statistics on the country's fertilizer consumption (IFADATA). According to the FAO-FUBC-Ukraine report, wheat is planted throughout the country but is more concentrated in the eastern region (Forest-Steppe Right Bank and Steppe) on the border to Russia. Similarly, according to USDA-FAS, wheat in Russia "is grown mainly in the fertile *chernozem* (black soil) zone, which includes the Southern district, the southern tier of the Central district, and the southern and central Volga district" of the region on the border with Ukraine. Therefore, we used Russian application rates from the IFA 2009 report as a reference to calculate those of Ukraine.

The methodology applied consisted of assuming that there exists an underlying production function of wheat that is common to Ukraine and Russia, and both countries are positioned at some point along the curve describing the response of wheat yields to applications of fertilizer (one curve for each of the three nutrients). From the FAPRI model we know wheat yields from both countries so we know where they lie on the vertical axis. Given that we do not know the form of the underlying production function (it requires unavailable data to estimate it), we make the simplifying assumption that the production function is increasing and linear; therefore, we apply the percentage difference between both countries' yields to the Russian fertilizer rate from IFA 2009. We could give this production function some curvature describing decreasing or increasing returns to scale, but the curvature imposed would also be an ad hoc assumption, unless we are able to find that curvature for each crop and for each country. Instead of considering the observed yield for 2006/07 and 2007/08, we used a proxy of the expected yield by taking the average of the yields from 2003/04 to 2007/08. This was done to avoid big swings in fertilizer rates due to big changes in yields caused by, for example, extreme weather events. Figure 1 shows why this is the case. Let y_R^1 and N_R^1 be the observed Russian yield and nitrogen rate, respectively, on a given year and let y_U^1 be that of Ukraine in the same year. We know these values from FAPRI and IFA 2009 data. Suppose that y_R^1 is low because of a bad weather event that affected only Russia but not Ukraine. This implies an application rate for Ukraine of N_U^1 according to the procedure described above. Suppose now that in all previous years Russian yields were actually higher, with the average equal to y_R^2 . In that case, the application rate for Ukraine consistent with y_R^2 would be N_U^2 , which is lower. Because fertilization decisions are mostly made before weather is observed, using the average yield implies that the farmer is looking at an expected production function. Weather shifts the production function up and down (dashed lines), but at planting the farmer is concerned with a production function consistent with expected conditions (solid line). For a similar reason, we used an average of the Ukrainian yields between 2003/04 and 2007/08.

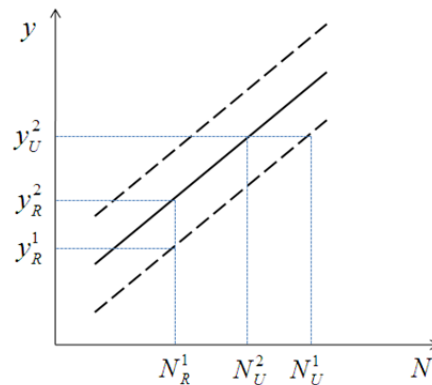


Figure 1. Example of obtaining the nitrogen application rate for a country using the expected production function

The same procedure was used to calculate the fertilizer application rates for corn in Ukraine. Regarding sugar crops and according to FAPRI, Ukraine only plants sugar beet and not sugarcane, so the fertilizer demand was calculated and subtracted from the ROW. The FAO-FUBC-Ukraine report gives one point of the sugar beet production for each nutrient in 2002. By assuming that this production function is linear and has not changed since 2002, each nutrient application rate was obtained for the years 2006/07 and 2007/08. In the case of "Other Oilseeds," FAPRI reports that Ukraine produces rapeseed and sunflower.

The sunflower rate was obtained in a similar manner to that of sugar beet with data also from FAO-FUBC-Ukraine. However no data for Ukraine was found on rapeseed and therefore we used the fertilizer rate from a neighboring country such as Hungary. With these two rates, their fertilizer demand was obtained and subtracted from that of the ROW. Finally we calculated the fertilizer rates for Ukrainian “Other Coarse Grains,” which according to FAPRI are barley, oats, and rye. For each of these crops, we assumed that Ukraine has the same linear production function as Russia and calculated each nutrient’s application rate in a similar way as what was done in the case of wheat and corn.

When a region instead of a country was reported by FAPRI, each fertilizer application rate was obtained as follows. For a given crop, we took the average yield of the countries in the region (with yields obtained from the USDA-FAS “Production, Supply and Distribution” dataset). Then, in most cases, we used the FAO 2002 report to obtain each country’s nutrient application rate and constructed an average of the nutrient rate for the region, where the weights were given by the planted area in each country (with planted areas also obtained from the USDA-FAS “Production, Supply and Distribution” dataset). The FAO 2002 was the preferred source of data because it is the report that spans most of the relevant countries and crops with fertilizer application rates from 1998 to 2000. Then, having found a yield and an application rate for the region, we have a point in the underlying production function for one year (usually between 1998 and 2000). Next, assuming that the production function had not changed, we obtained the fertilizer rate for the region in 2006/07 and 2007/08, using the methodology just described.

We show the 2007/08 fertilizer application rates for N, P, and K for each country and crop covered by FAPRI in Appendix B.

Projection of Fertilizer Application Rates

We seek to find a fertilizer application rate (nutrient/crop/country-specific) whose variation in each year is a function of the relevant variables of the decision process. The FAPRI-ISU model is capable of producing this variation, in particular, through the yield equations.

The FAPRI model has, for each crop and country, its respective yield and area equation and projects the country’s crop production as the product of its yield and harvested area. The fertilizer decision affects the total cost of production, which in turn is one of the explanatory variables of the FAPRI yield equation. Therefore, to obtain a fertilizer demand projection that is a function of the relevant variables in the model, we induce interaction between the fertilizer application rate (N, P, and K) and the yield equation in each country, by means of an underlying production function. The procedure is as follows.

The yield equation stated below accounts for three drivers: a time trend, an intensification component, and an extensification component. We are interested in the intensification terms because they account for the cost of production, and it is through these terms that the fertilizer application rates induce their effect.

$$y_{it} = \alpha + \beta Trend_t + \delta \left(\frac{TRev_{it}}{NFCost_{it} + FCost_{it}} \right) + \gamma \left(\frac{TRev_{i10y-ave}}{TCost_{i10y-ave}} \right) + \lambda a_{it} + \kappa (\sum a_{it}) + \epsilon_t$$

where $TCost_{it} = NFCost_{it} + FCost_{it}$ is the total variable cost expressed as the sum of the non-fertilizer cost and the fertilizer cost. The fertilizer cost is the sum of prices times quantities of each nutrient N, P,

and K ($Fcost_{it} = p_{Nit}N_{it} + p_{Pit}P_{it} + p_{Kit}K_{it}$). Suppose there exists an underlying production function for country i that determines the yield at time t , y_{it}^1 . Holding everything else constant, except the application of nitrogen fertilizer, this production function is described by a curve of the form shown in Figure 2. Therefore such a yield is consistent with a certain per hectare nitrogen application rate, N_{it}^1 . If we assume that the consistent nitrogen rate is the one found in the “Accounting Model,” we have one point on the production function curve. When the FAPRI-ISU model makes its first iteration (indexed by the superscript), a new value for the yield is found (y_{it}^2), which will be consistent with a different nitrogen application rate (N_{it}^2), consistency that is given by the curvature of the production function at that point. Therefore, we must know the curvature (elasticity of yields with respect to changes in N application rates) of the underlying production function for each country and each crop covered by FAPRI (these are explained in the next section).

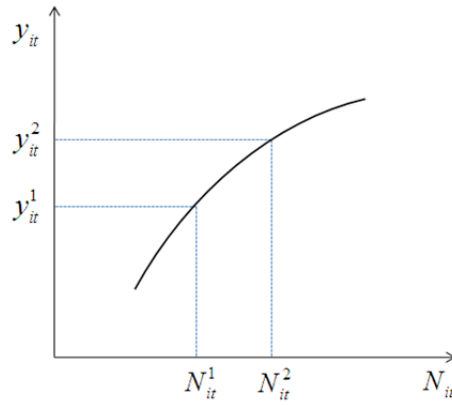


Figure 2. Underlying production function to determine yield response to nitrogen application rate

Before the third iteration, the total cost of production ($Fcost_{it}$) has to be updated with the new nitrogen application rate just found (N_{it}^2); that is, $Fcost_{it}^3 = Fcost_{it}^2(1 + g \cdot w)$ where g is the change in the nitrogen rate and w is the weight of nitrogen in the fertilizer cost. The value of g is a function of the elasticity of the production function. Then, a yield will be obtained in the third iteration (y_{it}^3), which according to the curvature of the production function determines a new nitrogen application rate of N_{it}^3 . This process continues until the market for this crop clears. Also, the process is repeated for each year projected by FAPRI, which allows us to obtain the fertilizer application rate projection.

The obtained nitrogen application rate will then be multiplied by the projected harvested area to obtain the corresponding fertilizer demand projection. The case of phosphorous and potash is the same as that of nitrogen.

Fertilizer Input Prices at the Country Level

The variable cost of production is composed of fertilizer costs plus non-fertilizer costs. Fertilizer costs at the country level are obtained by multiplying the country-specific fertilizer rate of a given crop times a country-specific fertilizer price. In order to obtain fertilizer prices (landed nutrient prices), we took the world fertilizer price for each nutrient (assumed to be the U.S. price), multiplied by the exchange rate, and applied the import tariffs of the country of interest. U.S. fertilizer prices (urea, superphosphate triple, and

potassium chloride) were obtained from USDA-NASS and projected using the “Cost of Production Model.” Exchange rates by country are readily available, and import tariffs were obtained from the World Trade Organization database.

Production Function Elasticities for Each Crop

We seek to find an underlying production function from which to obtain the response of crop yields to the application of fertilizer for each country. The ideal situation would be to estimate a country- and crop-specific production function, so that an elasticity of yields with respect to the application of nutrients can be obtained for each country. This is not possible with the available data because it requires cross-section or time-series data on input use by crop and by country. Therefore, we are forced to produce a less ambitious estimation. In this sense, for each commodity, we take the nutrient application rates from the Accounting Model or from other sources² and the crop yield from FAPRI or from USDA-FAS and use these pairs to fit a “world” production function. This will give us a yield response curve for each nutrient and for each crop, and the elasticity will be given by where the country is located in the production function. Results will be conditional on the form of the production function chosen. We also assume that all countries share the same technology functional form for producing a given crop. We explain the procedure used with an example for corn.

The production function with raw country data is plotted in blue in each of the nutrient dimensions, as shown in Figure 3. We fitted a Cobb-Douglas production function to these yield data as a function of the three nutrients ($y = AN^\alpha P^\beta K^\gamma e^\epsilon$). For this functional form, the elasticity with respect to each input is exactly its exponent. The estimation output showing statistically significant estimates of elasticities is shown in Table 2. Figure 3 shows the case of nitrogen, where the raw data used in the estimation is in blue and the fitted Cobb-Douglas production function is in red (graphs for phosphorous and potassium are in Appendix C). The higher elasticity with respect to nitrogen implies that nitrogen rates will be less

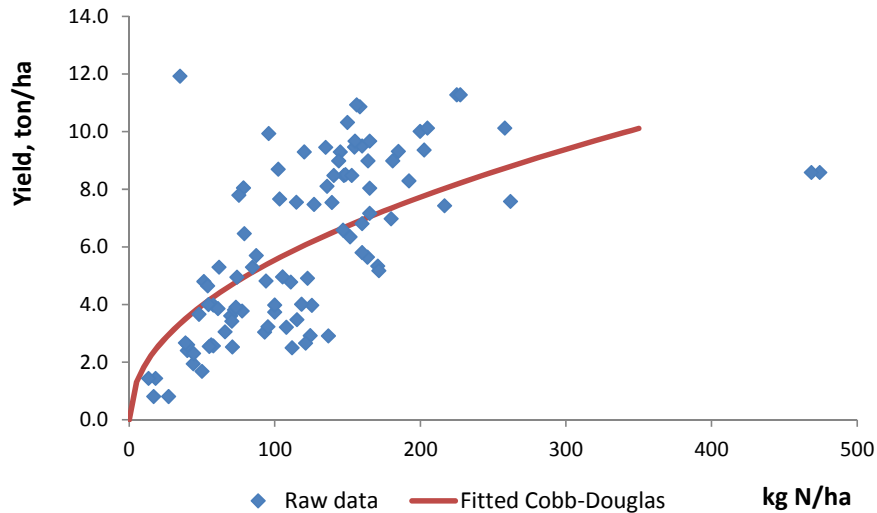


Figure 3. Corn yield response to nitrogen

² USDA-ERS, IFA, and Fertilizers Europe.

responsive to corn price changes than those of phosphorous and potassium. This is consistent with the country data of aggregate consumption of nutrients where the latter changes more from year to year. The explanation hinges on the fact that N has to be applied every year (so in that sense is more inelastic) while P and K are stored nutrients so the farmer can “wait” until price conditions are more favorable to purchase them. The lack of other input data at the crop and country level does not allow us to specify the technology as a function of other relevant inputs in the crop production process.

Table 2. Estimated elasticities for corn (Equation: $\ln(y) = \ln(A) + \alpha \ln(N) + \beta \ln(P) + \gamma \ln(K)$)

| Variable | $\ln(A)$ | $\ln(N_{corn})$ | $\ln(P_{corn})$ | $\ln(K_{corn})$ |
|----------------|----------|-----------------|-----------------|-----------------|
| Coefficient | -1.396 | 0.480 | 0.174 | 0.067 |
| Standard error | 0.294 | 0.092 | 0.094 | 0.038 |
| t-stat | -4.744 | 5.201 | 1.850 | 1.787 |
| p-value | 0.000 | 0.000 | 0.068 | 0.077 |

For some commodities (sorghum, sunflower, and sugarcane) we estimated a production function of the form $y = A(N + P + K)^\alpha e^\varepsilon$ because we did not have enough observations of nutrient use but observations on aggregate nutrients use by crop were available, especially for India. In other cases (soybeans, rapeseed, and sugar beet) we estimated the following form of production function: $y = AN^\alpha (P + K)^\beta e^\varepsilon$, because the estimate of the P or K elasticity was of the unexpected sign.

The estimated Cobb-Douglas elasticities of yield with respect to fertilizer rate are shown in Table 3 for each nutrient and for each commodity. It is important to highlight that these elasticities are then multiplied by the share of fertilizers in the total cost of production, so that we are not attributing all the change in yields to changes in fertilizer application rates.

Table 3. Estimated Cobb-Douglas Yield Elasticities

| | Wheat, All | Corn | Barley | Oats | Rye | Sorghum | Soybeans | Peanut | Rapeseed | Sunflower | Palm Oil | Rice, All | Cotton | Sugar Beet | Sugar Cane |
|----------|------------|-------|--------|-------|-------|---------|----------|--------|----------|-----------|----------|-----------|--------|------------|------------|
| N | 0.736 | 0.480 | 0.366 | 0.712 | 0.712 | 0.147 | 0.072 | 0.072 | 0.325 | 0.141 | 0.043 | 0.249 | 0.573 | 0.245 | 0.124 |
| P | 0.064 | 0.174 | 0.066 | 0.127 | 0.127 | 0.147 | 0.262 | 0.262 | 0.034 | 0.141 | 0.043 | 0.046 | 0.074 | 0.342 | 0.124 |
| K | 0.064 | 0.067 | 0.066 | 0.127 | 0.127 | 0.147 | 0.262 | 0.262 | 0.034 | 0.141 | 0.043 | 0.048 | 0.074 | 0.342 | 0.124 |

Our results will be improved as we find more country-specific data on input use by crop (fertilizer and other inputs), so that its own production function can be estimated.

FAPRI U.S. Model. Within the FAPRI-ISU model, projections for the commodities covered in the U.S. come from another model, the “U.S. model.” These commodities are wheat, corn, oats, rye, sorghum, soybeans, rapeseed, sunflower, peanuts, sugar beet, sugarcane, rice, and cotton. Also, the model divides the U.S. into the following six regions: Central Plains, Corn Belt, Delta States, Lake-States Northeast, Northern Plains, and Southeast. As a result, each commodity and region requires a fertilizer application rate (by nutrient) and the elasticity of yields with respect to each nutrient.

From USDA-ERS, fertilizer use by nutrient, by crop, and by state is available for wheat, corn, soybeans, and cotton between 1980 and 2007. This dataset was used to calculate the N, P, and K application rates for the base years, and to estimate the required elasticities (note that yields by state and by crop are available at USDA-NASS). Below, in Table 4, we show our estimated elasticities for soybeans in the U.S. coming from a Cobb-Douglas production function in which P and K are lumped together and in which regional dummy variables are included (relative to the Southeast region).

Table 4. Estimated elasticities for soybeans in the United States (Equation: $\ln(y) = \ln(A) + \alpha \ln(N) + \beta \ln(P + K)$)

| Variable | $\ln(A)$ | $\ln(N)$ | $\ln(P + K)$ | Central Plains | Corn Belt | Delta States | Lake States | North-east | Northern Plains |
|-------------|----------|----------|--------------|----------------|-----------|--------------|-------------|------------|-----------------|
| Coefficient | -0.947 | 0.072 | 0.262 | 0.489 | 0.355 | -0.004 | 0.410 | 0.219 | 0.373 |
| Std. Error | 0.282 | 0.029 | 0.061 | 0.058 | 0.029 | 0.033 | 0.044 | 0.099 | 0.071 |
| t-stat | -3.363 | 2.435 | 4.328 | 8.378 | 12.063 | -0.115 | 9.357 | 2.223 | 5.284 |
| p-value | 0.001 | 0.015 | 0.000 | 0.000 | 0.000 | 0.909 | 0.000 | 0.027 | 0.000 |

Elasticities of yield are significant and with the expected sign. The low value of the elasticity with respect to N is reasonable because of the low response of soybean yields to the addition of nitrogen fertilizer. For the cases of soybeans, wheat, and cotton we estimated elasticities with data from the U.S. However, for the remaining commodities we applied the elasticities estimated from the world production function. These elasticities are shown in Table 5.

Table 5. Estimated Cobb-Douglas yield elasticities for the United States

| | Wheat, All | Corn | Barley | Oats | Rye | Sorghum | Soybeans | Peanut | Rapeseed | Sunflower | Rice, All | Cotton | Sugar Beet | Sugar Cane |
|----------|------------|-------|--------|-------|-------|---------|----------|--------|----------|-----------|-----------|--------|------------|------------|
| N | 0.170 | 0.480 | 0.366 | 0.712 | 0.712 | 0.147 | 0.072 | 0.072 | 0.325 | 0.141 | 0.249 | 0.573 | 0.369 | 0.124 |
| P | 0.037 | 0.174 | 0.066 | 0.127 | 0.127 | 0.147 | 0.262 | 0.262 | 0.034 | 0.141 | 0.046 | 0.074 | 0.203 | 0.124 |
| K | 0.037 | 0.067 | 0.066 | 0.127 | 0.127 | 0.147 | 0.262 | 0.262 | 0.034 | 0.141 | 0.048 | 0.074 | 0.203 | 0.124 |
| | * | ** | ** | ** | ** | ** | * | ** | ** | ** | ** | * | ** | ** |

(*): Based on U.S. data only. (**): Corresponds with world production function.

Fertilizer Demand Baseline Projections

We present fertilizer demand projections by nutrient, by crop, and by year, for the world and a selected group of countries and crops. The complete set of projections, including all the countries and crops covered by the model, are available at <http://www.fapri.iastate.edu/outlook/2011/>. Baseline projections are through year 2025/26.

World fertilizer use in 2025/26 is projected to be 185 mmt, composed of 107 mmt of nitrogen (N) fertilizers, 43 mmt of phosphorous (P), and 35 mmt of potassium (K). This increase of 5.50% relative to the 2010/11 crop season reflects the expansion of the world's cropland by 4.36% and also the more

intensive use of fertilizers at the world level in commodities such as corn, barley, rapeseed, peanut, and cotton. These are shown in the tables in Appendix D.

World fertilizer use in corn is projected to be 17.20 mmt of N, 5.29 mmt of P, and 4.93 mmt of K, which represent increments of 4.63%, 8.01%, and 15.09%, respectively, relative to 2010/11. The higher percentage increase of P and K relative to N hinges upon their more elastic behavior relative to corn price changes. The higher fertilizer use in corn is due to the increase in both corn harvested areas and fertilizer application rates. World N use in soybean is projected at 1.43 mmt, 4.72 mmt of P, and 4.41 mmt of K in 2025. These imply similar levels of N and increases of 6.29% and 3.64% in P and K, respectively, relative to 2010. This is caused by the increase in soybean harvested area of 7.66% that offsets the decrease in nutrients application rates per hectare (induced by lower-than-2010 soybean prices projected to 2025). Fertilizer use in wheat at the world level is projected at 17.85 mmt of N, 6.25 mmt of P, and 2.11 mmt of K, which implies levels similar to 2010/11 because the increase in harvested areas of 0.88% compensates for the less intensive use of fertilizers in this crop.

Fertilizer use in the U.S. increases by 6.09%, driven by the higher use of fertilizers in corn, sorghum, and rapeseed, as shown in Appendix D. Corn N use in the U.S. in 2025 is projected at 5.66 mmt, 2.42 of P, and 3.21 mmt of K, which represents increments of 10.45%, 12.39%, and 17.51%, respectively, with respect to 2010. Both the more intensive and extensive corn production contributes to these changes. Fertilizer use in soybean experiences a reduction of 2.96% because of the decrease in U.S. soybean areas in that period. The case of wheat is similar, with even a stronger reduction of 10.09%, but in this case this is induced by the reduction in area as well as the fertilizer application rates.

China, India, the U.S., and the EU-27 countries account for more than two-thirds (65%) of the world's fertilizer consumption in agriculture. China is the world's top consuming country, followed by the U.S. China is characterized not only by large crop areas but also by an intensive use of fertilizers, which is comparable to (and even higher than in the cases of wheat, sunflower seed, peanuts, cotton, sugarcane, and sugar beet) those of the U.S. and EU-27 countries. India, on the other hand, is the third-largest fertilizer consumer, given its larger crop areas, but it has more moderate fertilizer application rates. China's fertilizer use slightly increases from 2010 to 2025, induced by the increase in the use of N because there is a shift in area toward crops that are more intensive in the use of N, such as corn, sugar beet, and cotton. China is expected to use 33.70 mmt of N, 12.16 mmt of P, and 6.49 mmt of K, which represents increments of 3.00%, 0.55% and 2.91% respectively, with respect to 2010. Indian fertilizer use increases over the projected period, driven by higher uses in oilseeds, wheat, and sugarcane. India's projected use in 2025 is 15.37 mmt of N, 5.78 mmt of P, and 2.75 mmt of K, which relative to 2010 is respectively 4.03%, 0.89% and 4.60% higher.

Fertilizer demand projections are a function of projected fertilizer application rates and harvested areas. We report fertilizer application rates by nutrient for all countries and commodities from our WorldNPK model in <http://www.fapri.iastate.edu/outlook/2011/>. For illustration purposes we show the projection of China's rates by crop in Appendix E. The main drivers of these rates are the variables included in the intensification component of each crop and country yield equation. Examples are the crop price and other input prices. We usually do not expect significant changes in the levels of these application rates, because small changes translate into sizable effects on a nutrient's total demand. Corn N rates are expected to increase by 1.12%, P rates by 3.09%, and K rates by 8.16%. Rates for P and K in corn are more

responsive to output price changes than are N rates, and other cereals such as barley and wheat have similar rate responses. The reason is that while P and K are nutrients that can be stored in the soil, N has to be applied every year, and this makes it less elastic to changes in relevant variables. Soybean rates are expected to decrease over the projected period as a result of similar behavior of world soybean projected prices. An analogous result is expected for sunflower seed.

Further Extensions (Step 2)

So far, the model assumes a horizontal world supply of each nutrient such that changes in demand are satisfied without affecting fertilizer prices. We plan to introduce a supply curve, not only to overcome this simplified assumption but also to project a world fertilizer price of equilibrium that clears the world fertilizer market. The supply of fertilizers will have a short-term component that reflects capacity constraints in the industry and a long-term component that is more elastic with respect to prices to reflect capacity building.

Therefore, the output of the model once this change is introduced will be a country- and crop-specific nutrient application rate that is a function of the relevant variables in the fertilizing decision process, and when multiplied by the harvested areas will give projections of fertilizer demands by crop and country. Also, we will be able to project an endogenous world price for each nitrogen, phosphorous, and potash component consistent with the fertilizer market clearing assumption.

References

- Fertilizers Europe. “Fertilizers Europe data base on nutrient application rate by crop”. 2010.
- Food and Agriculture Organization of the United Nations – FAO, 2002. “Fertilizer Use by Crop” Fifth edition.
- Food and Agriculture Organization of the United Nations – FAO, 2006. “Fertilizer and Plant Nutrition Bulletin: Fertilizer Use by Crop.”
- Food and Agriculture Organization of the United Nations – FAO, 2005. “Fertilizer Use by Crop in Ukraine.”
- Government of India - Ministry of Agriculture - “Agricultural Census” 1986, 1991, 1996, and 2001.
- Heffer, Patrick. “Assessment of Fertilizer Use by Crop at the Global Level 2006/07 – 2007/08,” International Fertilizer Industry Association - IFA, April 2009.
- International Fertilizer Industry Association (IFA), Statistics – IFADATA, 2009. Available at: <http://www.fertilizer.org/ifa/Home-Page/STATISTICS> (accessed September 2010).
- U.S. Department of Agriculture, Economic Research Service (USDA-ERS) “Fertilizer Use and Prices.” Available at <http://www.ers.usda.gov/data/fertilizeruse/> (Accessed September 2010).
- U.S. Department of Agriculture, Foreign Agricultural Service (USDA-FAS). “Production Estimates and Crop Assessment. Russia: Agricultural Overview.” Available at: http://www.fas.usda.gov/pecad2/highlights/2005/03/Russia_Ag/index.htm (accessed September 2010).
- U.S. Department of Agriculture, Foreign Agricultural Service (USDA-FAS). “Production, Supply and Distribution Online.” Available at <http://www.fas.usda.gov/psdonline/> (accessed September 2010).
- World Trade Organization - World Bank – World Integrated Trade Solutions (WITS). Available at <http://wits.worldbank.org/WITS//index.html> (accessed October 2010).

Appendix A. Worldwide Fertilizer Consumption (Source: IFA 2009)

Fertilizer Use by Crop ('000 t nutrients)
2006 + 2006/07

Last update: 7 April 2009

| | | CEREALS | | | | | | | | | | | | | | | | OILSEEDS | | | | | | | | | | | | | |
|-----------|-------------------------------|---------|------------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|----------|-------|-------|-------|----------|-------|----------|-------|----------|--------|--------|-------|-------------|-----|---------------|-----|-------------|-----|
| | | Wheat | | | | Rice | | | | Maize | | | | Other CG | | | | Soybean | | Oil Palm | | Other OS | | Cotton | | Sugar Crops | | Fruits & Veg. | | Other Crops | |
| | | Total | % of World | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty |
| China | N | 30,200 | 31.5% | 14.1% | 4,258 | 18.2% | 5,496 | 16.1% | 4,862 | 1.0% | 302 | 1.5% | 453 | 0.0% | 6 | 4.8% | 1,450 | 4.1% | 1,238 | 1.5% | 453 | 30.0% | 9,060 | 8.7% | 2,621 | | | | | | |
| | P ₂ O ₅ | 11,600 | 30.3% | 16.5% | 1,914 | 15.3% | 1,775 | 6.6% | 766 | 1.0% | 116 | 3.3% | 383 | 0.0% | 2 | 5.0% | 580 | 3.9% | 452 | 2.2% | 255 | 34.0% | 3,944 | 12.2% | 1,413 | | | | | | |
| | K ₂ O | 5,800 | 21.4% | 4.4% | 255 | 28.0% | 1,624 | 2.2% | 128 | 1.0% | 58 | 1.0% | 58 | 0.1% | 6 | 2.3% | 133 | 1.2% | 70 | 4.8% | 278 | 50.0% | 2,900 | 5.0% | 290 | | | | | | |
| | N+P+K | 47,600 | 29.5% | 13.5% | 6,427 | 18.7% | 8,895 | 12.1% | 5,755 | 1.0% | 476 | 1.9% | 894 | 0.0% | 14 | 4.5% | 2,163 | 3.7% | 1,760 | 2.1% | 987 | 33.4% | 15,904 | 9.1% | 4,325 | | | | | | |
| India | N | 13,773 | 14.4% | 21.0% | 2,892 | 30.0% | 4,132 | 2.5% | 344 | 4.5% | 620 | 1.0% | 138 | 0.0% | 0 | 4.5% | 620 | 6.5% | 895 | 5.0% | 689 | 7.0% | 964 | 18.0% | 2,479 | | | | | | |
| | P ₂ O ₅ | 5,543 | 14.5% | 20.0% | 1,109 | 25.0% | 1,386 | 1.5% | 83 | 5.0% | 277 | 2.5% | 139 | 0.0% | 0 | 7.0% | 388 | 8.0% | 443 | 4.5% | 249 | 11.0% | 610 | 15.5% | 859 | | | | | | |
| | K ₂ O | 2,335 | 8.6% | 8.0% | 187 | 34.0% | 794 | 1.0% | 23 | 2.5% | 58 | 1.0% | 23 | 0.0% | 0 | 5.0% | 117 | 5.5% | 128 | 10.0% | 234 | 22.0% | 514 | 11.0% | 257 | | | | | | |
| | N+P+K | 21,651 | 13.4% | 19.3% | 4,188 | 29.2% | 6,312 | 2.1% | 451 | 4.4% | 955 | 1.4% | 300 | 0.0% | 0 | 5.2% | 1,125 | 6.8% | 1,467 | 5.4% | 1,172 | 9.6% | 2,088 | 16.6% | 3,595 | | | | | | |
| USA | N | 11,970 | 12.5% | 13.4% | 1,604 | 1.9% | 227 | 48.4% | 5,793 | 3.4% | 407 | 0.8% | 96 | 0.0% | 0 | 1.5% | 180 | 2.4% | 287 | 1.0% | 120 | 4.2% | 503 | 23.0% | 2,753 | | | | | | |
| | P ₂ O ₅ | 4,148 | 10.8% | 13.7% | 568 | 0.9% | 37 | 48.6% | 2,016 | 2.3% | 95 | 7.4% | 307 | 0.0% | 0 | 2.1% | 87 | 3.1% | 129 | 1.1% | 46 | 5.8% | 241 | 15.0% | 622 | | | | | | |
| | K ₂ O | 4,657 | 17.1% | 4.8% | 224 | 0.8% | 37 | 50.0% | 2,329 | 1.0% | 47 | 10.8% | 503 | 0.0% | 0 | 2.0% | 93 | 3.3% | 154 | 2.9% | 135 | 6.8% | 317 | 17.6% | 820 | | | | | | |
| | N+P+K | 20,775 | 12.9% | 11.5% | 2,396 | 1.5% | 302 | 48.8% | 10,138 | 2.6% | 549 | 4.4% | 906 | 0.0% | 0 | 1.7% | 360 | 2.7% | 570 | 1.4% | 300 | 5.1% | 1,060 | 20.2% | 4,195 | | | | | | |
| EU-27 | N | 10,746 | 11.2% | 26.0% | 2,794 | 0.4% | 43 | 12.0% | 1,290 | 16.0% | 1,719 | 0.1% | 11 | 0.0% | 0 | 9.2% | 989 | 0.5% | 54 | 2.1% | 226 | 7.5% | 806 | 26.2% | 2,815 | | | | | | |
| | P ₂ O ₅ | 3,091 | 8.1% | 19.5% | 603 | 0.5% | 15 | 13.2% | 408 | 15.9% | 491 | 0.3% | 9 | 0.0% | 0 | 8.2% | 253 | 0.7% | 22 | 3.6% | 111 | 13.4% | 414 | 24.7% | 763 | | | | | | |
| | K ₂ O | 3,592 | 13.2% | 12.7% | 456 | 0.9% | 32 | 11.9% | 427 | 12.8% | 460 | 0.3% | 11 | 0.0% | 0 | 9.9% | 356 | 0.6% | 22 | 5.9% | 212 | 14.4% | 517 | 30.6% | 1,099 | | | | | | |
| | N+P+K | 17,429 | 10.8% | 22.1% | 3,853 | 0.5% | 91 | 12.2% | 2,125 | 15.3% | 2,671 | 0.2% | 31 | 0.0% | 0 | 9.2% | 1,598 | 0.6% | 97 | 3.1% | 549 | 10.0% | 1,737 | 26.8% | 4,678 | | | | | | |
| Brazil | N | 2,297 | 2.4% | 3.0% | 69 | 7.1% | 163 | 29.4% | 675 | 4.1% | 94 | 3.8% | 87 | 0.2% | 5 | 0.1% | 2 | 7.4% | 170 | 23.3% | 535 | 6.8% | 156 | 14.8% | 340 | | | | | | |
| | P ₂ O ₅ | 3,149 | 8.2% | 2.1% | 66 | 4.6% | 145 | 20.6% | 649 | 2.0% | 63 | 41.3% | 1,301 | 0.1% | 3 | 0.1% | 3 | 4.5% | 142 | 8.7% | 274 | 5.0% | 157 | 11.0% | 346 | | | | | | |
| | K ₂ O | 3,460 | 12.7% | 1.8% | 62 | 4.1% | 142 | 16.7% | 578 | 0.9% | 31 | 34.7% | 1,201 | 0.2% | 7 | 0.1% | 3 | 4.1% | 142 | 20.6% | 713 | 5.4% | 187 | 11.4% | 394 | | | | | | |
| | N+P+K | 8,906 | 5.5% | 2.2% | 197 | 5.1% | 450 | 21.4% | 1,902 | 2.1% | 188 | 29.1% | 2,588 | 0.2% | 15 | 0.1% | 9 | 5.1% | 454 | 17.1% | 1,522 | 5.6% | 500 | 12.1% | 1,081 | | | | | | |
| Pakistan | N | 2,649 | 2.8% | 37.9% | 1,004 | 9.4% | 249 | 4.8% | 127 | 0.6% | 16 | 0.0% | 0 | 0.0% | 0 | 1.1% | 29 | 18.8% | 498 | 6.6% | 175 | 3.8% | 101 | 17.0% | 450 | | | | | | |
| | P ₂ O ₅ | 979 | 2.6% | 35.2% | 345 | 9.1% | 89 | 6.2% | 61 | 0.5% | 5 | 0.0% | 0 | 0.0% | 0 | 1.5% | 15 | 16.0% | 157 | 8.1% | 79 | 4.1% | 40 | 19.3% | 189 | | | | | | |
| | K ₂ O | 43 | 0.2% | 34.0% | 15 | 11.0% | 5 | 11.0% | 5 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 9.0% | 4 | 11.0% | 5 | 11.0% | 5 | 13.0% | 6 | | | | | | |
| | N+P+K | 3,671 | 2.3% | 37.1% | 1,363 | 9.3% | 343 | 5.2% | 193 | 0.6% | 21 | 0.0% | 0 | 0.0% | 0 | 1.2% | 44 | 17.9% | 659 | 7.1% | 259 | 4.0% | 146 | 17.6% | 645 | | | | | | |
| Indonesia | N | 2,350 | 2.5% | 0.0% | 0 | 45.0% | 1,058 | 15.0% | 353 | 0.0% | 0 | 0.4% | 9 | 13.0% | 306 | 1.0% | 24 | 0.1% | 1 | 2.0% | 47 | 9.0% | 212 | 14.6% | 342 | | | | | | |
| | P ₂ O ₅ | 480 | 1.3% | 0.0% | 0 | 22.0% | 106 | 15.0% | 72 | 0.0% | 0 | 3.0% | 14 | 25.0% | 120 | 3.0% | 14 | 0.2% | 1 | 5.0% | 24 | 10.0% | 48 | 16.9% | 81 | | | | | | |
| | K ₂ O | 800 | 2.9% | 0.0% | 0 | 14.0% | 112 | 10.0% | 80 | 0.0% | 0 | 0.6% | 5 | 48.0% | 384 | 1.0% | 8 | 0.1% | 0 | 9.0% | 72 | 12.0% | 96 | 5.4% | 43 | | | | | | |
| | N+P+K | 3,630 | 2.3% | 0.0% | 0 | 35.1% | 1,275 | 13.9% | 505 | 0.0% | 0 | 0.8% | 29 | 22.3% | 810 | 1.3% | 46 | 0.1% | 2 | 3.9% | 143 | 9.8% | 356 | 12.8% | 466 | | | | | | |
| Canada | N | 1,758 | 1.8% | 33.6% | 591 | 0.0% | 0 | 8.9% | 156 | 14.7% | 258 | 0.5% | 9 | 0.0% | 0 | 20.4% | 359 | 0.0% | 0 | 0.5% | 9 | 0.6% | 11 | 20.8% | 366 | | | | | | |
| | P ₂ O ₅ | 469 | 1.2% | 36.9% | 173 | 0.0% | 0 | 8.8% | 41 | 17.6% | 83 | 6.2% | 29 | 0.0% | 0 | 16.9% | 79 | 0.0% | 0 | 0.6% | 3 | 0.7% | 3 | 12.3% | 58 | | | | | | |
| | K ₂ O | 382 | 1.4% | 9.4% | 36 | 0.0% | 0 | 22.5% | 86 | 2.8% | 11 | 8.1% | 31 | 0.0% | 0 | 20.8% | 79 | 0.0% | 0 | 0.6% | 2 | 1.9% | 7 | 33.9% | 129 | | | | | | |
| | N+P+K | 2,609 | 1.6% | 30.6% | 800 | 0.0% | 0 | 10.9% | 284 | 13.5% | 352 | 2.6% | 69 | 0.0% | 0 | 19.8% | 517 | 0.0% | 0 | 0.5% | 14 | 0.8% | 21 | 21.2% | 553 | | | | | | |
| Vietnam | N | 1,123 | 1.2% | 0.0% | 0 | 68.0% | 764 | 12.0% | 135 | 0.0% | 0 | 0.7% | 8 | 0.0% | 0 | 1.5% | 17 | 0.2% | 2 | 4.0% | 45 | 3.0% | 34 | 10.6% | 119 | | | | | | |
| | P ₂ O ₅ | 600 | 1.6% | 0.0% | 0 | 72.0% | 432 | 7.5% | 45 | 0.0% | 0 | 1.5% | 9 | 0.0% | 0 | 3.0% | 18 | 0.1% | 1 | 2.5% | 15 | 4.0% | 24 | 9.4% | 56 | | | | | | |
| | K ₂ O | 408 | 1.5% | 0.0% | 0 | 66.0% | 269 | 6.5% | 27 | 0.0% | 0 | 1.5% | 6 | 0.0% | 0 | 3.0% | 12 | 0.1% | 0 | 8.0% | 33 | 5.0% | 20 | 9.9% | 40 | | | | | | |
| | N+P+K | 2,131 | 1.3% | 0.0% | 0 | 68.7% | 1,465 | 9.7% | 206 | 0.0% | 0 | 1.1% | 23 | 0.0% | 0 | 2.2% | 47 | 0.2% | 3 | 4.3% | 93 | 3.7% | 78 | 10.1% | 216 | | | | | | |
| Turkey | N | 1,407 | 1.5% | 41.5% | 584 | 0.9% | 13 | 6.8% | 96 | 12.1% | 170 | 0.1% | 1 | 0.0% | 0 | 4.6% | 65 | 5.4% | 76 | 2.0% | 28 | 17.0% | 239 | 9.6% | 135 | | | | | | |
| | P ₂ O ₅ | 605 | 1.6% | 41.7% | 252 | 0.9% | 5 | 4.7% | 28 | 13.1% | 79 | 0.1% | 1 | 0.0% | 0 | 4.4% | 27 | 5.2% | 31 | 3.4% | 21 | 14.4% | 87 | 12.1% | 73 | | | | | | |
| | K ₂ O | 99 | 0.4% | 15.2% | 15 | 0.5% | 0 | 6.1% | 6 | 2.9% | 3 | 0.1% | 0 | 0.0% | 0 | 5.4% | 5 | 4.2% | 4 | 13.2% | 13 | 40.4% | 40 | 12.0% | 12 | | | | | | |
| | N+P+K | 2,111 | 1.3% | 40.3% | 851 | 0.9% | 19 | 6.2% | 130 | 12.0% | 252 | 0.1% | 2 | 0.0% | 0 | 4.6% | 97 | 5.3% | 112 | 2.9% | 62 | 17.4% | 366 | 10.4% | 220 | | | | | | |
| Australia | N | 858 | 0.9% | 30.7% | 263 | 0.0% | 0 | 0.7% | 6 | 24.1% | 207 | 0.0% | 0 | 0.0% | 0 | 10.3% | 88 | 0.7% | 6 | 8.2% | 70 | 8.4% | 72 | 16.9% | 145 | | | | | | |
| | P ₂ O ₅ | 984 | 2.6% | 28.9% | 284 | 0.0% | 0 | 0.4% | 4 | 24.0% | 236 | 0.0% | 0 | 0.0% | 0 | 7.7% | 76 | 0.3% | 3 | 3.1% | 31 | 4.9% | 48 | 30.7% | 302 | | | | | | |
| | K ₂ O | 224 | 0.8% | 12.6% | 28 | 0.0% | 0 | 0.2% | 0 | 5.7% | 13 | 0.0% | 0 | 0.0% | 0 | 3.4% | 8 | 0.4% | 1 | 19.8% | 44 | 24.0% | 54 | 33.9% | 76 | | | | | | |
| | N+P+K | 2,066 | 1.3% | 27.9% | 576 | 0.0% | 0 | 0.5% | 10 | 22.1% | 456 | 0.0% | 0 | 0.0% | 0 | 8.3% | 172 | 0.5% | 10 | 7.0% | 145 | 8.4% | 174 | 25.3% | 523 | | | | | | |
| Malaysia | N | 540 | 0.6% | 0.0% | 0 | 15.0% | 81 | 0.5% | 3 | 0.0% | 0 | 0.0% | 0 | 65.0% | 351 | 0.2% | 1 | 0.0% | 0 | 0.3% | 2 | 3.0% | 16 | 16.1% | 87 | | | | | | |
| | P ₂ O ₅ | 230 | 0.6% | 0.0% | 0 | 19.0% | 44 | 0.5% | 1 | 0.0% | 0 | 0.0% | 0 | 55.0% | 127 | 0.2% | 0 | 0.0% | 0 | 0.3% | 1 | 6.0% | 14 | 19.0% | 44 | | | | | | |
| | K ₂ O | 1,000 | 3.7% | 0.0% | 0 | 5.0% | 50 | 0.1% | 1 | 0.0% | 0 | 0.0% | 0 | 85.0% | 850 | 0.1% | 1 | 0.0% | 0 | 0.2% | 2 | 2.0% | 20 | 7.7% | 77 | | | | | | |
| | N+P+K | 1,770 | 1.1% | 0.0% | 0 | 9.9% | 175 | 0.3% | 5 | 0.0% | 0 | 0.0% | 0 | 75.0% | 1,328 | 0.1% | 2 | 0.0% | 0 | 0.2% | 4 | 2.8% | 50 | 11.7% | 207 | | | | | | |

| | | CEREALS | | | | | | | | | OILSEEDS | | | | | | | | | | | | | | |
|--------------|-------------------------------|---------|--------|-------|----------|---------|----------|----------|--------|-------------|--------------|-------------|-------|-------|-------|------|-------|------|-------|-------|-------|-------|--------|-------|--------|
| | | Wheat | Rice | Maize | Other CG | Soybean | Oil Palm | Other OS | Cotton | Sugar Crops | Fruits & Veg | Other Crops | | | | | | | | | | | | | |
| Iran | N | 1,150 | 1.2% | 36.0% | 414 | 7.5% | 86 | 5.5% | 63 | 8.0% | 92 | 0.2% | 2 | 0.0% | 0 | 4.5% | 52 | 2.0% | 23 | 3.5% | 40 | 15.0% | 173 | 17.8% | 205 |
| | P ₂ O ₅ | 500 | 1.3% | 34.0% | 170 | 5.5% | 28 | 5.0% | 25 | 7.5% | 38 | 0.8% | 4 | 0.0% | 0 | 6.5% | 33 | 1.5% | 8 | 3.5% | 18 | 23.0% | 115 | 12.7% | 63 |
| | K ₂ O | 200 | 0.7% | 24.0% | 48 | 4.0% | 8 | 3.5% | 7 | 5.5% | 11 | 0.3% | 1 | 0.0% | 0 | 4.5% | 9 | 1.5% | 3 | 2.5% | 5 | 44.0% | 88 | 10.2% | 20 |
| | N+P+K | 1,850 | 1.1% | 34.2% | 632 | 6.6% | 122 | 5.1% | 95 | 7.6% | 141 | 0.4% | 7 | 0.0% | 0 | 5.0% | 93 | 1.8% | 34 | 3.4% | 63 | 20.3% | 376 | 15.6% | 289 |
| Thailand | N | 1,034 | 1.1% | 0.0% | 0 | 30.0% | 310 | 7.0% | 72 | 0.5% | 5 | 0.1% | 1 | 3.0% | 31 | 1.0% | 10 | 1.0% | 10 | 5.0% | 52 | 28.0% | 290 | 24.4% | 252 |
| | P ₂ O ₅ | 333 | 0.9% | 0.0% | 0 | 25.0% | 83 | 7.0% | 23 | 0.5% | 2 | 1.0% | 3 | 6.0% | 20 | 1.5% | 5 | 1.0% | 3 | 10.0% | 33 | 30.0% | 100 | 18.0% | 60 |
| | K ₂ O | 341 | 1.3% | 0.0% | 0 | 5.0% | 17 | 10.0% | 34 | 0.5% | 2 | 0.1% | 0 | 10.0% | 34 | 1.0% | 3 | 1.0% | 3 | 13.0% | 44 | 36.0% | 123 | 23.4% | 80 |
| | N+P+K | 1,708 | 1.1% | 0.0% | 0 | 24.0% | 411 | 7.6% | 130 | 0.5% | 9 | 0.3% | 5 | 5.0% | 85 | 1.1% | 19 | 1.0% | 17 | 7.6% | 129 | 30.0% | 512 | 23.0% | 392 |
| Bangladesh | N | 1,193 | 1.2% | 1.2% | 14 | 93.3% | 1,113 | 0.3% | 4 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.8% | 10 | 0.2% | 2 | 0.7% | 8 | 1.5% | 18 | 2.0% | 24 |
| | P ₂ O ₅ | 285 | 0.7% | 1.5% | 4 | 83.0% | 237 | 0.3% | 1 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 2.0% | 6 | 0.2% | 1 | 1.5% | 4 | 5.0% | 14 | 6.5% | 19 |
| | K ₂ O | 170 | 0.6% | 1.7% | 3 | 81.0% | 138 | 0.3% | 1 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 2.0% | 3 | 0.4% | 1 | 2.0% | 3 | 5.0% | 9 | 7.6% | 13 |
| | N+P+K | 1,648 | 1.0% | 1.3% | 21 | 90.2% | 1,487 | 0.3% | 5 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 1.1% | 19 | 0.2% | 3 | 1.0% | 16 | 2.5% | 41 | 3.4% | 56 |
| Russia | N | 956 | 1.0% | 42.0% | 402 | 1.2% | 11 | 7.3% | 70 | 22.0% | 210 | 0.4% | 4 | 0.0% | 0 | 2.3% | 22 | 0.0% | 0 | 9.6% | 92 | 1.0% | 10 | 14.2% | 136 |
| | P ₂ O ₅ | 423 | 1.1% | 40.0% | 169 | 1.1% | 5 | 5.5% | 23 | 21.0% | 89 | 1.1% | 5 | 0.0% | 0 | 7.1% | 30 | 0.0% | 0 | 15.0% | 63 | 1.4% | 6 | 7.8% | 33 |
| | K ₂ O | 268 | 1.0% | 26.0% | 70 | 0.1% | 0 | 5.7% | 15 | 23.0% | 62 | 0.8% | 2 | 0.0% | 0 | 4.1% | 11 | 0.0% | 0 | 24.0% | 64 | 3.7% | 10 | 12.6% | 34 |
| | N+P+K | 1,647 | 1.0% | 38.9% | 640 | 1.0% | 16 | 6.6% | 108 | 21.9% | 361 | 0.6% | 11 | 0.0% | 0 | 3.8% | 63 | 0.0% | 0 | 13.3% | 220 | 1.5% | 25 | 12.3% | 203 |
| Mexico | N | 1,120 | 1.2% | 5.3% | 59 | 0.5% | 6 | 61.3% | 687 | 1.8% | 20 | 18.0% | 0 | 1.2% | 13 | 0.2% | 2 | 0.5% | 6 | 6.1% | 68 | 14.9% | 167 | 8.2% | 92 |
| | P ₂ O ₅ | 260 | 0.7% | 2.9% | 8 | 0.8% | 2 | 40.0% | 104 | 0.8% | 2 | 1.2% | 3 | 4.0% | 10 | 0.2% | 1 | 1.2% | 3 | 8.8% | 23 | 32.0% | 83 | 8.1% | 21 |
| | K ₂ O | 220 | 0.8% | 1.2% | 3 | 0.9% | 2 | 9.0% | 20 | 0.0% | 0 | 0.9% | 2 | 4.5% | 10 | 0.0% | 0 | 0.9% | 2 | 27.8% | 61 | 47.1% | 104 | 7.7% | 17 |
| | N+P+K | 1,600 | 1.0% | 4.3% | 70 | 0.6% | 10 | 50.6% | 810 | 1.4% | 22 | 0.3% | 5 | 2.1% | 34 | 0.2% | 3 | 0.7% | 11 | 9.5% | 152 | 22.1% | 354 | 8.1% | 130 |
| Egypt | N | 1,260 | 1.3% | 24.0% | 302 | 9.0% | 113 | 27.0% | 340 | 4.5% | 57 | 0.1% | 1 | 0.0% | 0 | 1.0% | 13 | 3.5% | 44 | 4.0% | 50 | 19.0% | 239 | 7.9% | 100 |
| | P ₂ O ₅ | 240 | 0.6% | 14.5% | 35 | 8.5% | 20 | 10.5% | 25 | 2.5% | 6 | 0.2% | 0 | 0.0% | 0 | 1.5% | 4 | 4.5% | 11 | 3.0% | 7 | 45.0% | 108 | 9.8% | 24 |
| | K ₂ O | 49 | 0.2% | 20.0% | 10 | 0.0% | 0 | 15.0% | 7 | 2.0% | 1 | 0.1% | 0 | 0.0% | 0 | 0.5% | 0 | 4.0% | 2 | 15.0% | 7 | 35.0% | 17 | 8.4% | 4 |
| | N+P+K | 1,549 | 1.0% | 22.4% | 347 | 8.6% | 134 | 24.1% | 373 | 4.1% | 64 | 0.1% | 2 | 0.0% | 0 | 1.1% | 16 | 3.7% | 57 | 4.2% | 65 | 23.5% | 365 | 8.2% | 127 |
| Argentina | N | 759 | 0.8% | 36.9% | 280 | 0.7% | 5 | 29.0% | 220 | 5.3% | 40 | 6.6% | 50 | 0.0% | 0 | 3.3% | 25 | 0.7% | 5 | 3.3% | 25 | 7.2% | 55 | 7.0% | 53 |
| | P ₂ O ₅ | 639 | 1.7% | 25.8% | 165 | 0.4% | 3 | 17.2% | 110 | 6.3% | 40 | 34.4% | 220 | 0.0% | 0 | 3.1% | 20 | 0.2% | 1 | 0.2% | 1 | 6.3% | 40 | 6.1% | 39 |
| | K ₂ O | 55 | 0.2% | 2.2% | 1 | 4.2% | 2 | 2.2% | 1 | 0.5% | 0 | 2.0% | 1 | 0.0% | 0 | 0.9% | 0 | 0.2% | 0 | 10.0% | 6 | 54.5% | 30 | 23.3% | 13 |
| | N+P+K | 1,453 | 0.9% | 30.7% | 446 | 0.7% | 10 | 22.8% | 331 | 5.6% | 81 | 18.7% | 271 | 0.0% | 0 | 3.1% | 45 | 0.5% | 7 | 2.2% | 32 | 8.6% | 125 | 7.2% | 105 |
| South Africa | N | 429 | 0.4% | 7.2% | 31 | 0.0% | 0 | 48.0% | 206 | 1.4% | 6 | 0.1% | 0 | 0.0% | 0 | 4.3% | 18 | 0.3% | 1 | 11.5% | 49 | 11.5% | 49 | 15.7% | 67 |
| | P ₂ O ₅ | 204 | 0.5% | 10.0% | 20 | 0.0% | 0 | 41.0% | 84 | 1.7% | 3 | 0.7% | 1 | 0.0% | 0 | 6.2% | 13 | 0.6% | 1 | 13.0% | 27 | 12.0% | 24 | 14.8% | 30 |
| | K ₂ O | 153 | 0.6% | 4.6% | 7 | 0.0% | 0 | 13.5% | 21 | 0.5% | 1 | 0.3% | 0 | 0.0% | 0 | 1.1% | 2 | 0.2% | 0 | 43.0% | 66 | 25.0% | 38 | 11.8% | 18 |
| | N+P+K | 786 | 0.5% | 7.4% | 58 | 0.0% | 0 | 39.5% | 310 | 1.3% | 10 | 0.3% | 2 | 0.0% | 0 | 4.2% | 33 | 0.4% | 3 | 18.0% | 142 | 14.3% | 112 | 14.7% | 116 |
| Philippines | N | 520 | 0.5% | 0.0% | 0 | 40.0% | 208 | 20.0% | 104 | 0.0% | 0 | 0.0% | 0 | 0.5% | 3 | 2.0% | 10 | 0.0% | 0 | 2.0% | 10 | 20.0% | 104 | 15.5% | 81 |
| | P ₂ O ₅ | 110 | 0.3% | 0.0% | 0 | 30.0% | 33 | 12.0% | 13 | 0.0% | 0 | 0.0% | 0 | 0.5% | 1 | 5.0% | 6 | 0.0% | 0 | 6.0% | 7 | 30.0% | 33 | 16.5% | 18 |
| | K ₂ O | 110 | 0.4% | 0.0% | 0 | 10.0% | 11 | 5.0% | 6 | 0.0% | 0 | 0.0% | 0 | 3.0% | 3 | 3.0% | 3 | 0.0% | 0 | 15.0% | 17 | 50.0% | 55 | 14.0% | 15 |
| | N+P+K | 740 | 0.5% | 0.0% | 0 | 34.1% | 252 | 16.6% | 123 | 0.0% | 0 | 0.0% | 0 | 0.9% | 6 | 2.6% | 19 | 0.0% | 0 | 4.5% | 34 | 25.9% | 192 | 15.4% | 114 |
| Chile | N | 254 | 0.3% | 18.0% | 46 | 0.8% | 2 | 12.0% | 30 | 6.0% | 15 | 0.0% | 0 | 0.0% | 0 | 0.8% | 2 | 0.0% | 0 | 1.6% | 4 | 20.0% | 51 | 40.8% | 104 |
| | P ₂ O ₅ | 143 | 0.4% | 18.0% | 26 | 1.3% | 2 | 6.7% | 10 | 6.0% | 9 | 0.0% | 0 | 0.0% | 0 | 0.6% | 1 | 0.0% | 0 | 1.2% | 2 | 10.0% | 14 | 56.2% | 80 |
| | K ₂ O | 95 | 0.3% | 6.0% | 6 | 2.0% | 2 | 9.0% | 9 | 2.0% | 2 | 0.0% | 0 | 0.0% | 0 | 0.5% | 0 | 0.0% | 0 | 6.0% | 6 | 45.0% | 43 | 29.5% | 28 |
| | N+P+K | 492 | 0.3% | 15.7% | 77 | 1.2% | 6 | 9.9% | 49 | 5.2% | 26 | 0.0% | 0 | 0.0% | 0 | 0.7% | 3 | 0.0% | 0 | 2.3% | 11 | 21.9% | 108 | 43.1% | 212 |
| Morocco | N | 226 | 0.2% | 28.0% | 63 | 0.4% | 1 | 3.0% | 7 | 19.0% | 43 | 0.0% | 0 | 0.0% | 0 | 2.2% | 5 | 0.0% | 0 | 5.5% | 12 | 20.0% | 45 | 21.9% | 49 |
| | P ₂ O ₅ | 153 | 0.4% | 28.0% | 43 | 0.3% | 0 | 3.5% | 5 | 19.0% | 29 | 0.0% | 0 | 0.0% | 0 | 3.6% | 6 | 0.0% | 0 | 5.5% | 8 | 18.0% | 28 | 22.1% | 34 |
| | K ₂ O | 53 | 0.2% | 14.0% | 7 | 0.0% | 0 | 2.8% | 1 | 11.0% | 6 | 0.0% | 0 | 0.0% | 0 | 1.4% | 1 | 0.0% | 0 | 9.5% | 5 | 50.0% | 27 | 11.3% | 6 |
| | N+P+K | 432 | 0.3% | 26.3% | 114 | 0.3% | 1 | 3.2% | 14 | 18.0% | 78 | 0.0% | 0 | 0.0% | 0 | 2.6% | 11 | 0.0% | 0 | 6.0% | 26 | 23.0% | 99 | 20.7% | 89 |
| ROW | N | 7,257 | 7.6% | 13.0% | 943 | 14.0% | 1,016 | 13.0% | 943 | 6.0% | 436 | 0.5% | 36 | 0.7% | 51 | 5.0% | 363 | 5.0% | 363 | 5.0% | 363 | 18.0% | 1,306 | 19.8% | 1,437 |
| | P ₂ O ₅ | 3,070 | 8.0% | 10.0% | 307 | 12.0% | 368 | 10.0% | 307 | 6.0% | 184 | 5.0% | 154 | 1.0% | 31 | 5.0% | 154 | 5.0% | 154 | 6.0% | 184 | 20.0% | 614 | 20.0% | 614 |
| | K ₂ O | 2,643 | 9.7% | 7.0% | 185 | 12.0% | 317 | 10.0% | 264 | 4.0% | 106 | 3.0% | 79 | 4.0% | 106 | 4.0% | 106 | 3.0% | 79 | 12.0% | 317 | 25.0% | 661 | 16.0% | 423 |
| | N+P+K | 12,970 | 8.0% | 11.1% | 1,435 | 13.1% | 1,702 | 11.7% | 1,515 | 5.6% | 725 | 2.1% | 269 | 1.4% | 187 | 4.8% | 622 | 4.6% | 596 | 6.7% | 864 | 19.9% | 2,581 | 19.1% | 2,474 |
| World | N | 95,829 | 100.0% | 17.3% | 16,614 | 15.8% | 15,098 | 17.3% | 16,587 | 4.9% | 4,718 | 0.9% | 907 | 0.8% | 765 | 4.5% | 4,354 | 3.8% | 3,682 | 3.3% | 3,173 | 15.3% | 14,679 | 15.9% | 15,252 |
| | P ₂ O ₅ | 38,238 | 100.0% | 16.4% | 6,261 | 12.6% | 4,815 | 12.8% | 4,904 | 4.8% | 1,848 | 6.8% | 2,582 | 0.8% | 313 | 4.7% | 1,816 | 4.1% | 1,561 | 3.9% | 1,486 | 17.8% | 6,810 | 15.3% | 5,843 |
| | K ₂ O | 27,157 | 100.0% | 6.0% | 1,617 | 13.1% | 3,563 | 15.0% | 4,075 | 3.2% | 870 | 7.1% | 1,924 | 5.2% | 1,400 | 3.5% | 955 | 2.3% | 616 | 8.6% | 2,344 | 21.7% | 5,880 | 14.4% | 3,914 |
| | N+P+K | 161,224 | 100.0% | 15.2% | 24,492 | 14.6% | 23,478 | 15.9% | 25,566 | 4.6% | 7,435 | 3.4% | 5,412 | 1.5% | 2,478 | 4.4% | 7,125 | 3.6% | 5,859 | 4.3% | 7,002 | 17.0% | 27,369 | 15.5% | 25,009 |

Source: International Fertilizer Industry Association, AgCom/09/28

Fertilizer Use by Crop ('000 t nutrients)
2007 + 2007/08

Last update: 7 April 2009

| | | | | CEREALS | | | | | | | | OILSEEDS | | | | | Cotton | | Sugar Crops | | Fruits & Veg. | | Other Crops | | |
|-----------|-------------------------------|--------|------------|---------|-------|-------|-------|-------|-------|----------|-------|----------|-------|----------|-----|----------|--------|-------|-------------|-------|---------------|-------|-------------|-------|-------|
| | | | | Wheat | | Rice | | Maize | | Other CG | | Soybean | | Oil Palm | | Other OS | | | | | | | | | |
| | | Total | % of World | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty | % | Qty |
| China | N | 32,000 | 31.8% | 13.5% | 4,320 | 17.6% | 5,632 | 15.8% | 5,056 | 1.0% | 320 | 1.4% | 448 | 0.0% | 6 | 4.5% | 1,440 | 4.3% | 1,376 | 1.6% | 512 | 31.0% | 9,920 | 9.3% | 2,970 |
| | P ₂ O ₅ | 12,000 | 30.5% | 16.0% | 1,920 | 15.0% | 1,800 | 7.0% | 840 | 1.0% | 120 | 3.0% | 360 | 0.0% | 2 | 4.7% | 564 | 4.1% | 492 | 2.3% | 276 | 34.0% | 4,080 | 12.9% | 1,546 |
| | K ₂ O | 6,200 | 21.5% | 4.0% | 248 | 28.0% | 1,736 | 2.2% | 136 | 1.0% | 62 | 1.0% | 62 | 0.1% | 6 | 2.2% | 136 | 1.3% | 81 | 5.0% | 310 | 50.0% | 3,100 | 5.2% | 322 |
| | N+P+K | 50,200 | 29.8% | 12.9% | 6,488 | 18.3% | 9,168 | 12.0% | 6,032 | 1.0% | 502 | 1.7% | 870 | 0.0% | 14 | 4.3% | 2,140 | 3.9% | 1,949 | 2.2% | 1,098 | 34.1% | 17,100 | 9.6% | 4,838 |
| India | N | 14,633 | 14.6% | 21.0% | 3,073 | 30.0% | 4,390 | 2.5% | 366 | 4.5% | 658 | 1.0% | 146 | 0.0% | 0 | 4.5% | 658 | 6.5% | 951 | 5.0% | 732 | 7.0% | 1,024 | 18.0% | 2,634 |
| | P ₂ O ₅ | 5,726 | 14.6% | 20.0% | 1,145 | 25.0% | 1,432 | 1.5% | 86 | 5.0% | 286 | 2.5% | 143 | 0.0% | 0 | 7.0% | 401 | 8.0% | 458 | 4.5% | 258 | 11.0% | 630 | 15.5% | 888 |
| | K ₂ O | 2,657 | 9.2% | 8.0% | 213 | 34.0% | 903 | 1.0% | 27 | 2.5% | 66 | 1.0% | 66 | 0.0% | 0 | 5.0% | 133 | 5.5% | 146 | 10.0% | 266 | 22.0% | 585 | 11.0% | 292 |
| | N+P+K | 23,016 | 13.6% | 19.3% | 4,431 | 29.2% | 6,725 | 2.1% | 478 | 4.4% | 1,011 | 1.4% | 316 | 0.0% | 0 | 5.2% | 1,192 | 6.8% | 1,555 | 5.5% | 1,255 | 9.7% | 2,239 | 16.6% | 3,814 |
| USA | N | 11,610 | 11.5% | 13.2% | 1,533 | 2.2% | 255 | 46.7% | 5,422 | 3.5% | 406 | 1.0% | 116 | 0.0% | 0 | 1.6% | 186 | 2.2% | 255 | 1.0% | 116 | 4.4% | 511 | 24.2% | 2,810 |
| | P ₂ O ₅ | 4,080 | 10.4% | 14.7% | 600 | 1.1% | 45 | 43.9% | 1,791 | 2.3% | 94 | 10.5% | 428 | 0.0% | 0 | 2.1% | 86 | 2.7% | 110 | 1.1% | 45 | 6.0% | 245 | 15.6% | 636 |
| | K ₂ O | 4,540 | 15.7% | 5.0% | 227 | 1.0% | 45 | 45.8% | 2,079 | 1.0% | 45 | 14.9% | 676 | 0.0% | 0 | 2.1% | 95 | 3.0% | 136 | 2.9% | 132 | 6.8% | 309 | 17.5% | 795 |
| | N+P+K | 20,230 | 12.0% | 11.7% | 2,359 | 1.7% | 346 | 45.9% | 9,292 | 2.7% | 546 | 6.0% | 1,221 | 0.0% | 0 | 1.8% | 367 | 2.5% | 502 | 1.4% | 293 | 5.3% | 1,064 | 21.0% | 4,241 |
| EU-27 | N | 11,617 | 11.6% | 27.8% | 3,230 | 0.4% | 46 | 11.9% | 1,382 | 16.7% | 1,940 | 0.1% | 12 | 0.0% | 0 | 8.7% | 1,011 | 0.5% | 58 | 1.8% | 209 | 7.1% | 825 | 25.0% | 2,904 |
| | P ₂ O ₅ | 3,454 | 8.8% | 21.8% | 753 | 0.5% | 17 | 13.0% | 449 | 17.3% | 598 | 0.3% | 10 | 0.0% | 0 | 7.9% | 273 | 0.6% | 21 | 3.1% | 107 | 12.4% | 428 | 23.1% | 798 |
| | K ₂ O | 3,865 | 13.4% | 14.3% | 553 | 0.8% | 31 | 12.2% | 472 | 13.1% | 506 | 0.3% | 12 | 0.0% | 0 | 9.8% | 379 | 0.5% | 19 | 5.3% | 205 | 13.8% | 533 | 29.9% | 1,156 |
| | N+P+K | 18,936 | 11.2% | 24.0% | 4,535 | 0.5% | 95 | 12.2% | 2,303 | 16.1% | 3,044 | 0.2% | 34 | 0.0% | 0 | 8.8% | 1,662 | 0.5% | 98 | 2.8% | 521 | 9.4% | 1,788 | 25.7% | 4,858 |
| Brazil | N | 2,751 | 2.7% | 2.9% | 80 | 5.3% | 146 | 31.1% | 856 | 4.0% | 110 | 3.9% | 107 | 0.2% | 6 | 0.1% | 3 | 8.4% | 231 | 22.3% | 613 | 6.6% | 182 | 15.2% | 418 |
| | P ₂ O ₅ | 3,659 | 9.3% | 2.1% | 77 | 3.9% | 143 | 20.0% | 732 | 1.9% | 70 | 42.4% | 1,551 | 0.1% | 4 | 0.1% | 4 | 4.4% | 161 | 8.6% | 315 | 5.0% | 183 | 11.5% | 421 |
| | K ₂ O | 4,175 | 14.5% | 1.8% | 75 | 3.7% | 154 | 18.5% | 772 | 1.0% | 42 | 34.1% | 1,424 | 0.2% | 8 | 0.1% | 4 | 3.7% | 154 | 20.4% | 852 | 5.3% | 221 | 11.2% | 468 |
| | N+P+K | 10,585 | 6.3% | 2.2% | 232 | 4.2% | 443 | 22.3% | 2,360 | 2.1% | 221 | 29.1% | 3,082 | 0.2% | 18 | 0.1% | 11 | 5.2% | 547 | 16.8% | 1,780 | 5.5% | 586 | 12.3% | 1,307 |
| Indonesia | N | 2,596 | 2.6% | 0.0% | 0 | 45.0% | 1,168 | 15.0% | 389 | 0.0% | 0 | 4.0% | 10 | 13.0% | 337 | 1.0% | 26 | 0.1% | 1 | 2.0% | 52 | 9.0% | 234 | 14.6% | 378 |
| | P ₂ O ₅ | 510 | 1.3% | 0.0% | 0 | 22.0% | 112 | 15.0% | 77 | 0.0% | 0 | 0.3% | 15 | 25.0% | 128 | 3.0% | 15 | 0.2% | 1 | 5.0% | 26 | 10.0% | 51 | 16.9% | 86 |
| | K ₂ O | 850 | 2.9% | 0.0% | 0 | 14.0% | 119 | 10.0% | 85 | 0.0% | 0 | 0.6% | 5 | 48.0% | 408 | 1.0% | 9 | 0.1% | 0 | 9.0% | 77 | 12.0% | 102 | 5.4% | 45 |
| | N+P+K | 3,956 | 2.3% | 0.0% | 0 | 35.4% | 1,399 | 13.9% | 551 | 0.0% | 0 | 0.8% | 31 | 22.1% | 873 | 1.3% | 50 | 0.1% | 2 | 3.9% | 154 | 9.8% | 387 | 12.9% | 509 |
| Pakistan | N | 2,923 | 2.9% | 37.0% | 1,082 | 9.1% | 266 | 4.8% | 140 | 0.6% | 18 | 0.0% | 0 | 1.2% | 35 | 18.5% | 541 | 7.9% | 231 | 4.1% | 120 | 16.8% | 120 | 16.8% | 491 |
| | P ₂ O ₅ | 627 | 1.6% | 34.1% | 214 | 8.5% | 53 | 6.1% | 38 | 0.5% | 3 | 0.0% | 0 | 1.6% | 10 | 15.7% | 98 | 9.6% | 60 | 4.8% | 30 | 19.1% | 120 | | |
| | K ₂ O | 29 | 0.1% | 27.0% | 8 | 11.0% | 3 | 11.0% | 3 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 8.0% | 2 | 15.0% | 4 | 15.0% | 4 | 13.0% | 4 | | |
| | N+P+K | 3,579 | 2.1% | 36.4% | 1,303 | 9.0% | 322 | 5.1% | 182 | 0.6% | 21 | 0.0% | 0 | 0.0% | 0 | 1.3% | 45 | 17.9% | 642 | 8.3% | 295 | 4.3% | 154 | 17.2% | 615 |
| Canada | N | 1,939 | 1.9% | 29.6% | 574 | 0.0% | 0 | 10.5% | 204 | 16.6% | 322 | 0.5% | 10 | 0.0% | 0 | 22.9% | 444 | 0.0% | 0 | 0.5% | 10 | 0.6% | 12 | 18.8% | 365 |
| | P ₂ O ₅ | 508 | 1.3% | 31.9% | 162 | 0.0% | 0 | 10.7% | 54 | 20.6% | 105 | 5.3% | 27 | 0.0% | 0 | 19.4% | 99 | 0.0% | 0 | 0.5% | 3 | 0.6% | 3 | 11.0% | 56 |
| | K ₂ O | 354 | 1.2% | 7.7% | 27 | 0.0% | 0 | 26.9% | 95 | 3.1% | 11 | 7.4% | 26 | 0.0% | 0 | 24.4% | 86 | 0.0% | 0 | 0.5% | 2 | 1.8% | 6 | 28.2% | 100 |
| | N+P+K | 2,801 | 1.7% | 27.2% | 763 | 0.0% | 0 | 12.6% | 353 | 15.6% | 437 | 2.2% | 63 | 0.0% | 0 | 22.5% | 629 | 0.0% | 0 | 0.5% | 14 | 0.8% | 21 | 18.6% | 520 |
| Vietnam | N | 1,136 | 1.1% | 0.0% | 0 | 68.0% | 772 | 12.0% | 136 | 0.0% | 0 | 0.7% | 8 | 0.0% | 0 | 1.5% | 17 | 0.2% | 2 | 4.0% | 45 | 3.0% | 34 | 10.6% | 120 |
| | P ₂ O ₅ | 631 | 1.6% | 0.0% | 0 | 72.0% | 454 | 7.5% | 47 | 0.0% | 0 | 1.5% | 9 | 0.0% | 0 | 3.0% | 19 | 0.1% | 1 | 2.5% | 16 | 4.0% | 25 | 9.4% | 59 |
| | K ₂ O | 433 | 1.5% | 0.0% | 0 | 66.0% | 286 | 6.5% | 28 | 0.0% | 0 | 1.5% | 6 | 0.0% | 0 | 3.0% | 13 | 0.1% | 0 | 8.0% | 35 | 5.0% | 22 | 9.9% | 43 |
| | N+P+K | 2,200 | 1.3% | 0.0% | 0 | 68.8% | 1,513 | 9.6% | 212 | 0.0% | 0 | 1.1% | 24 | 0.0% | 0 | 2.2% | 49 | 0.2% | 3 | 4.4% | 96 | 3.7% | 81 | 10.1% | 223 |
| Australia | N | 848 | 0.8% | 30.7% | 260 | 0.0% | 0 | 0.7% | 6 | 24.1% | 204 | 0.0% | 0 | 0.0% | 0 | 10.3% | 87 | 0.7% | 6 | 8.2% | 70 | 8.4% | 71 | 16.9% | 143 |
| | P ₂ O ₅ | 982 | 2.5% | 28.9% | 284 | 0.0% | 0 | 0.4% | 4 | 24.0% | 236 | 0.0% | 0 | 0.0% | 0 | 7.7% | 76 | 0.3% | 3 | 3.1% | 30 | 4.9% | 48 | 30.7% | 301 |
| | K ₂ O | 227 | 0.8% | 12.6% | 29 | 0.0% | 0 | 0.2% | 0 | 5.7% | 13 | 0.0% | 0 | 0.0% | 0 | 3.4% | 8 | 0.4% | 1 | 19.8% | 45 | 24.0% | 54 | 33.9% | 77 |
| | N+P+K | 2,057 | 1.2% | 27.8% | 573 | 0.0% | 0 | 0.5% | 10 | 22.0% | 453 | 0.0% | 0 | 0.0% | 0 | 8.3% | 171 | 0.5% | 10 | 7.0% | 145 | 8.5% | 174 | 25.4% | 522 |
| Turkey | N | 1,356 | 1.3% | 41.5% | 563 | 0.9% | 12 | 6.8% | 92 | 12.1% | 164 | 0.1% | 1 | 0.0% | 0 | 4.6% | 62 | 5.4% | 73 | 2.0% | 27 | 17.0% | 231 | 9.6% | 130 |
| | P ₂ O ₅ | 516 | 1.3% | 41.7% | 215 | 0.9% | 5 | 4.7% | 24 | 13.1% | 68 | 0.1% | 1 | 0.0% | 0 | 4.4% | 23 | 5.2% | 27 | 3.4% | 18 | 14.4% | 74 | 12.1% | 62 |
| | K ₂ O | 109 | 0.4% | 15.2% | 17 | 0.5% | 1 | 6.1% | 7 | 2.9% | 3 | 0.1% | 0 | 0.0% | 0 | 5.4% | 6 | 4.2% | 5 | 13.2% | 14 | 40.4% | 44 | 12.0% | 13 |
| | N+P+K | 1,981 | 1.2% | 40.1% | 794 | 0.9% | 17 | 6.2% | 123 | 11.9% | 235 | 0.1% | 2 | 0.0% | 0 | 4.6% | 91 | 5.3% | 105 | 3.0% | 59 | 17.6% | 349 | 10.4% | 206 |
| Russia | N | 1,175 | 1.2% | 42.0% | 494 | 1.2% | 14 | 7.3% | 86 | 22.0% | 259 | 0.4% | 5 | 0.0% | 0 | 2.3% | 27 | 0.0% | 0 | 9.6% | 113 | 1.0% | 12 | 14.2% | 167 |
| | P ₂ O ₅ | 470 | 1.2% | 40.0% | 188 | 1.1% | 5 | 5.5% | 26 | 21.0% | 99 | 1.1% | 5 | 0.0% | 0 | 7.1% | 33 | 0.0% | 0 | 15.0% | 71 | 1.4% | 7 | 7.8% | 37 |
| | K ₂ O | 296 | 1.0% | 26.0% | 77 | 0.1% | 0 | 5.7% | 17 | 23.0% | 68 | 0.8% | 2 | 0.0% | 0 | 4.1% | 12 | 0.0% | 0 | 24.0% | 71 | 3.7% | 11 | 12.6% | 37 |
| | N+P+K | 1,941 | 1.2% | 39.1% | 758 | 1.0% | 20 | 6.6% | 128 | 21.9% | 425 | 0.6% | 12 | 0.0% | 0 | 3.7% | 73 | 0.0% | 0 | 13.1% | 254 | 1.5% | 29 | 12.4% | 241 |

| | | CEREALS | | | | | | | | OILSEEDS | | | | | | | | | | | | | | | |
|--------------|-------------------------------|---------|--------|-------|----------|---------|----------|----------|--------|-------------|--------------|-------------|-------|-------|-------|------|-------|------|-------|-------|-------|-------|--------|-------|--------|
| | | Wheat | Rice | Maize | Other CG | Soybean | Oil Palm | Other OS | Cotton | Sugar Crops | Fruits & Veg | Other Crops | | | | | | | | | | | | | |
| Malaysia | N | 600 | 0.6% | 0 | 15.0% | 90 | 0.5% | 3 | 0.0% | 0 | 65.0% | 390 | 0.2% | 1 | 0.0% | 0 | 0.3% | 2 | 3.0% | 18 | 16.1% | 96 | | | |
| | P ₂ O ₅ | 250 | 0.6% | 0 | 19.0% | 47 | 0.5% | 1 | 0.0% | 0 | 55.0% | 138 | 0.2% | 1 | 0.0% | 0 | 0.3% | 2 | 6.0% | 15 | 19.0% | 48 | | | |
| | K ₂ O | 1,050 | 3.6% | 0 | 5.0% | 53 | 0.1% | 1 | 0.0% | 0 | 85.0% | 893 | 0.1% | 1 | 0.0% | 0 | 0.2% | 2 | 2.0% | 21 | 7.7% | 80 | | | |
| | N+P+K | 1,900 | 1.1% | 0.0% | 0 | 10.0% | 190 | 0.3% | 5 | 0.0% | 0 | 74.7% | 1,420 | 0.1% | 2 | 0.0% | 0 | 0.2% | 5 | 2.8% | 54 | 11.8% | 224 | | |
| Argentina | N | 903 | 0.9% | 37.7% | 340 | 0.6% | 5 | 29.9% | 270 | 5.5% | 50 | 6.6% | 60 | 0.0% | 0 | 3.3% | 30 | 0.6% | 5 | 2.8% | 25 | 6.6% | 60 | 6.4% | 58 |
| | P ₂ O ₅ | 695 | 1.8% | 25.9% | 180 | 0.4% | 3 | 17.3% | 120 | 6.5% | 45 | 34.5% | 240 | 0.0% | 0 | 2.9% | 20 | 0.1% | 1 | 0.1% | 3 | 7.2% | 50 | 5.1% | 35 |
| | K ₂ O | 65 | 0.2% | 2.3% | 1 | 3.8% | 2 | 1.5% | 1 | 0.5% | 0 | 2.0% | 1 | 0.0% | 0 | 0.9% | 1 | 0.2% | 0 | 10.8% | 7 | 53.8% | 35 | 24.2% | 16 |
| | N+P+K | 1,663 | 1.0% | 31.4% | 522 | 0.6% | 11 | 23.5% | 391 | 5.7% | 95 | 18.1% | 301 | 0.0% | 0 | 3.0% | 51 | 0.4% | 6 | 2.0% | 33 | 8.7% | 145 | 6.6% | 109 |
| Bangladesh | N | 1,240 | 1.2% | 1.1% | 14 | 93.5% | 1,159 | 0.4% | 5 | 0.0% | 0 | 0.0% | 0 | 0.8% | 10 | 0.2% | 2 | 0.6% | 7 | 1.5% | 19 | 1.9% | 24 | | |
| | P ₂ O ₅ | 220 | 0.6% | 2.1% | 5 | 78.0% | 172 | 0.4% | 1 | 0.0% | 0 | 0.0% | 0 | 2.5% | 6 | 0.2% | 0 | 1.5% | 3 | 6.0% | 13 | 9.3% | 20 | | |
| | K ₂ O | 170 | 0.6% | 1.6% | 3 | 80.3% | 137 | 0.4% | 1 | 0.0% | 0 | 0.0% | 0 | 2.0% | 3 | 0.4% | 1 | 2.0% | 3 | 5.0% | 9 | 8.3% | 14 | | |
| | N+P+K | 1,630 | 1.0% | 1.3% | 21 | 90.0% | 1,468 | 0.4% | 7 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 1.2% | 19 | 0.2% | 3 | 0.9% | 14 | 2.5% | 40 | 3.6% | 59 |
| Iran | N | 1,000 | 1.0% | 36.0% | 360 | 7.5% | 75 | 5.5% | 55 | 8.0% | 80 | 0.2% | 2 | 0.0% | 0 | 4.5% | 45 | 2.0% | 3 | 3.5% | 35 | 15.0% | 150 | 17.8% | 178 |
| | P ₂ O ₅ | 440 | 1.1% | 34.0% | 150 | 5.5% | 24 | 5.0% | 22 | 7.5% | 33 | 0.8% | 4 | 0.0% | 0 | 6.5% | 29 | 1.5% | 7 | 2.0% | 101 | 23.0% | 101 | 12.7% | 56 |
| | K ₂ O | 180 | 0.6% | 24.0% | 43 | 4.0% | 7 | 3.5% | 6 | 5.5% | 10 | 0.3% | 1 | 0.0% | 0 | 4.5% | 8 | 1.5% | 3 | 2.5% | 5 | 44.0% | 79 | 10.2% | 18 |
| | N+P+K | 1,620 | 1.0% | 34.1% | 553 | 6.6% | 106 | 5.1% | 83 | 7.6% | 123 | 0.4% | 6 | 0.0% | 0 | 5.0% | 82 | 1.8% | 29 | 3.4% | 55 | 20.4% | 330 | 15.6% | 252 |
| Mexico | N | 1,140 | 1.1% | 5.3% | 60 | 0.5% | 6 | 61.3% | 699 | 1.8% | 21 | 0.0% | 0 | 1.2% | 14 | 0.2% | 2 | 0.5% | 70 | 14.9% | 170 | 8.2% | 93 | | |
| | P ₂ O ₅ | 250 | 0.6% | 2.9% | 7 | 0.8% | 2 | 40.0% | 100 | 0.8% | 2 | 1.2% | 3 | 4.0% | 10 | 0.2% | 1 | 1.2% | 3 | 8.8% | 22 | 32.0% | 80 | 8.1% | 20 |
| | K ₂ O | 220 | 0.8% | 1.2% | 3 | 0.9% | 2 | 9.0% | 20 | 0.0% | 0 | 0.9% | 2 | 4.5% | 10 | 0.0% | 0 | 0.9% | 2 | 27.8% | 61 | 47.1% | 104 | 7.7% | 17 |
| | N+P+K | 1,610 | 1.0% | 4.4% | 70 | 0.6% | 10 | 50.8% | 819 | 1.4% | 23 | 0.3% | 5 | 2.1% | 34 | 0.2% | 3 | 0.7% | 11 | 9.5% | 153 | 22.0% | 353 | 8.1% | 131 |
| Egypt | N | 1,250 | 1.2% | 24.0% | 300 | 9.0% | 113 | 27.0% | 338 | 4.5% | 56 | 0.1% | 1 | 0.0% | 0 | 1.0% | 13 | 3.5% | 44 | 4.0% | 50 | 19.0% | 238 | 7.9% | 99 |
| | P ₂ O ₅ | 244 | 0.6% | 14.5% | 35 | 8.5% | 21 | 10.5% | 26 | 2.5% | 6 | 0.2% | 0 | 0.0% | 0 | 1.5% | 4 | 4.5% | 11 | 3.0% | 7 | 45.0% | 110 | 9.8% | 24 |
| | K ₂ O | 50 | 0.2% | 20.0% | 10 | 0.0% | 0 | 15.0% | 8 | 2.0% | 1 | 0.1% | 0 | 0.0% | 0 | 0.5% | 0 | 4.0% | 2 | 15.0% | 8 | 35.0% | 18 | 8.4% | 4 |
| | N+P+K | 1,544 | 0.9% | 22.4% | 345 | 8.6% | 133 | 24.0% | 371 | 4.1% | 63 | 0.1% | 2 | 0.0% | 0 | 1.1% | 16 | 3.7% | 57 | 4.2% | 65 | 23.6% | 365 | 8.2% | 127 |
| Thailand | N | 872 | 0.9% | 0.0% | 0 | 30.0% | 262 | 7.0% | 61 | 0.5% | 4 | 0.1% | 1 | 3.0% | 26 | 1.0% | 9 | 1.0% | 9 | 5.0% | 44 | 28.0% | 244 | 24.4% | 213 |
| | P ₂ O ₅ | 276 | 0.7% | 0.0% | 0 | 25.0% | 69 | 7.0% | 19 | 0.5% | 1 | 1.0% | 3 | 6.0% | 17 | 1.5% | 4 | 1.0% | 3 | 10.0% | 28 | 30.0% | 83 | 18.0% | 50 |
| | K ₂ O | 305 | 1.1% | 0.0% | 0 | 5.0% | 15 | 10.0% | 31 | 0.5% | 2 | 0.1% | 0 | 10.0% | 31 | 1.0% | 3 | 1.0% | 3 | 13.0% | 40 | 36.0% | 110 | 23.4% | 71 |
| | N+P+K | 1,453 | 0.9% | 0.0% | 0 | 23.8% | 346 | 7.6% | 111 | 0.5% | 7 | 0.3% | 4 | 5.0% | 73 | 1.1% | 16 | 1.0% | 15 | 7.6% | 111 | 30.1% | 437 | 23.0% | 334 |
| South Africa | N | 439 | 0.4% | 8.0% | 35 | 0.0% | 0 | 41.0% | 180 | 1.6% | 7 | 0.3% | 1 | 0.0% | 0 | 5.7% | 25 | 0.3% | 1 | 13.0% | 57 | 14.0% | 61 | 16.1% | 71 |
| | P ₂ O ₅ | 192 | 0.5% | 10.5% | 20 | 0.0% | 0 | 32.0% | 61 | 1.8% | 3 | 1.5% | 3 | 0.0% | 0 | 7.5% | 14 | 0.6% | 1 | 14.5% | 28 | 15.5% | 30 | 16.1% | 31 |
| | K ₂ O | 137 | 0.5% | 2.3% | 3 | 0.0% | 0 | 10.5% | 14 | 0.5% | 1 | 0.6% | 1 | 0.0% | 0 | 1.3% | 2 | 0.2% | 0 | 43.0% | 59 | 28.0% | 38 | 13.6% | 19 |
| | N+P+K | 768 | 0.5% | 7.6% | 58 | 0.0% | 0 | 33.3% | 256 | 1.5% | 11 | 0.7% | 5 | 0.0% | 0 | 5.4% | 41 | 0.4% | 3 | 18.7% | 144 | 16.9% | 130 | 15.7% | 120 |
| Philippines | N | 530 | 0.5% | 0.0% | 0 | 40.0% | 212 | 20.0% | 106 | 0.0% | 0 | 0.0% | 0 | 0.5% | 3 | 2.0% | 11 | 0.0% | 0 | 2.0% | 11 | 20.0% | 106 | 15.5% | 82 |
| | P ₂ O ₅ | 120 | 0.3% | 0.0% | 0 | 30.0% | 36 | 12.0% | 14 | 0.0% | 0 | 0.0% | 0 | 0.5% | 1 | 5.0% | 6 | 0.0% | 0 | 6.0% | 7 | 30.0% | 36 | 16.5% | 20 |
| | K ₂ O | 115 | 0.4% | 0.0% | 0 | 10.0% | 12 | 5.0% | 6 | 0.0% | 0 | 0.0% | 0 | 3.0% | 3 | 3.0% | 3 | 0.0% | 0 | 15.0% | 17 | 50.0% | 58 | 14.0% | 16 |
| | N+P+K | 765 | 0.5% | 0.0% | 0 | 33.9% | 260 | 16.5% | 126 | 0.0% | 0 | 0.0% | 0 | 0.9% | 7 | 2.6% | 20 | 0.0% | 0 | 4.6% | 35 | 26.1% | 200 | 15.4% | 118 |
| Chile | N | 268 | 0.3% | 18.0% | 48 | 0.7% | 2 | 13.0% | 35 | 6.0% | 16 | 0.0% | 0 | 0.8% | 2 | 0.0% | 0 | 1.6% | 4 | 20.0% | 54 | 39.9% | 54 | 39.9% | 107 |
| | P ₂ O ₅ | 163 | 0.4% | 18.5% | 30 | 1.2% | 2 | 7.5% | 12 | 6.0% | 10 | 0.0% | 0 | 0.6% | 1 | 0.0% | 0 | 1.2% | 2 | 10.0% | 16 | 55.0% | 90 | 28 | |
| | K ₂ O | 92 | 0.3% | 5.7% | 5 | 1.8% | 2 | 8.5% | 8 | 2.0% | 2 | 0.0% | 0 | 0.0% | 0 | 0.5% | 0 | 0.0% | 0 | 5.7% | 5 | 45.0% | 41 | 30.8% | 28 |
| | N+P+K | 523 | 0.3% | 16.0% | 84 | 1.0% | 5 | 10.5% | 55 | 5.3% | 28 | 0.0% | 0 | 0.0% | 0 | 0.7% | 4 | 0.0% | 0 | 2.2% | 11 | 21.3% | 111 | 43.0% | 225 |
| Morocco | N | 235 | 0.2% | 32.0% | 75 | 0.4% | 1 | 1.8% | 4 | 22.0% | 52 | 0.0% | 0 | 0.0% | 0 | 1.7% | 4 | 0.0% | 0 | 5.0% | 12 | 18.0% | 42 | 19.1% | 45 |
| | P ₂ O ₅ | 158 | 0.4% | 29.0% | 46 | 0.4% | 1 | 3.9% | 6 | 20.0% | 32 | 0.0% | 0 | 0.0% | 0 | 3.3% | 5 | 0.0% | 0 | 5.6% | 9 | 17.0% | 27 | 20.8% | 33 |
| | K ₂ O | 53 | 0.2% | 20.0% | 11 | 0.0% | 0 | 1.2% | 1 | 13.0% | 7 | 0.0% | 0 | 0.0% | 0 | 1.2% | 1 | 0.0% | 0 | 9.0% | 5 | 46.0% | 24 | 9.6% | 5 |
| | N+P+K | 446 | 0.3% | 29.5% | 132 | 0.4% | 2 | 2.5% | 11 | 20.2% | 90 | 0.0% | 0 | 0.0% | 0 | 2.2% | 10 | 0.0% | 0 | 5.7% | 25 | 21.0% | 94 | 18.6% | 83 |
| ROW | N | 7,468 | 7.4% | 13.0% | 971 | 14.0% | 1,046 | 13.0% | 971 | 6.0% | 448 | 0.5% | 37 | 0.7% | 52 | 5.0% | 373 | 5.0% | 373 | 18.0% | 1,344 | 19.8% | 1,479 | | |
| | P ₂ O ₅ | 3,316 | 8.4% | 10.0% | 332 | 12.0% | 398 | 10.0% | 332 | 6.0% | 199 | 5.0% | 166 | 1.0% | 33 | 5.0% | 166 | 5.0% | 166 | 6.0% | 199 | 20.0% | 663 | 20.0% | 663 |
| | K ₂ O | 2,703 | 9.4% | 7.0% | 189 | 12.0% | 324 | 10.0% | 270 | 4.0% | 108 | 3.0% | 81 | 4.0% | 108 | 4.0% | 108 | 3.0% | 81 | 12.0% | 324 | 25.0% | 676 | 16.0% | 432 |
| | N+P+K | 13,487 | 8.0% | 11.1% | 1,492 | 13.1% | 1,768 | 11.7% | 1,573 | 5.6% | 755 | 2.1% | 284 | 1.4% | 194 | 4.8% | 647 | 4.6% | 620 | 6.6% | 897 | 19.9% | 2,683 | 19.1% | 2,574 |
| World | N | 100,529 | 100.0% | 17.3% | 17,411 | 15.6% | 15,673 | 16.8% | 16,861 | 5.1% | 5,135 | 1.0% | 966 | 0.8% | 834 | 4.5% | 4,521 | 3.9% | 3,955 | 3.4% | 3,420 | 15.6% | 15,680 | 16.0% | 16,074 |
| | P ₂ O ₅ | 39,324 | 100.0% | 16.2% | 6,362 | 12.3% | 4,840 | 12.4% | 4,883 | 5.1% | 2,008 | 7.5% | 2,969 | 0.8% | 331 | 4.7% | 1,857 | 4.0% | 1,563 | 3.9% | 1,545 | 17.9% | 7,028 | 15.1% | 6,100 |
| | K ₂ O | 28,875 | 100.0% | 6.0% | 1,741 | 13.3% | 3,832 | 14.2% | 4,087 | 3.3% | 947 | 8.1% | 2,327 | 5.1% | 1,467 | 3.5% | 1,011 | 2.2% | 637 | 8.8% | 2,547 | 21.5% | 6,204 | 14.1% | 4,073 |
| | N+P+K | 168,728 | 100.0% | 15.1% | 25,514 | 14.4% | 24,343 | 15.3% | 25,832 | 4.8% | 8,091 | 3.7% | 6,261 | 1.6% | 2,632 | 4.4% | 7,389 | 3.6% | 6,156 | 4.5% | 7,512 | 17.1% | 28,912 | 15.6% | 26,248 |

Source: International Fertilizer Industry Association. AgCom/09/28

Appendix B. Fertilizer Application Rates, 2007/08 (Source: IFA 2009 and Author Calculations)

NITROGEN APPLICATION RATES (KG/HA of nutrients)

| | Wheat, All | Corn | Barley | Oats | Rye | Sorghum | Soy beans | Peanut | Rapeseed | Sunflower Seed | Palm Oil | Rice, All | Cotton | Sugar Beet | Sugar Cane |
|-----------------|------------|------|--------|------|-----|---------|-----------|--------|----------|----------------|----------|-----------|--------|------------|------------|
| Africa | | | | | | | | | | | | | | | 12 |
| Algeria | 28 | 17 | 10 | | | | | | | | | | | | |
| Argentina | 57 | 79 | 92 | | | 18 | 4 | 16 | | 10 | | 30 | 17 | | 84 |
| Australia | 21 | 87 | 35 | | | 35 | | | 68 | | | 0 | 91 | | 183 |
| Bangladesh | | | | | | | | | | | | 104 | | | |
| Brazil | 43 | 58 | 4 | | | | 5 | | | | | 51 | 215 | | 88 |
| Cambodia | | | | | | | | | | | | 7 | | | |
| Cameroon | | | | | | | | | | | | 3 | | | |
| Canada | 66 | 149 | 60 | 45 | | | 8 | 71 | | | 0 | 0 | 41 | | |
| China | 182 | 172 | 80 | | | | 51 | 101 | 169 | 108 | | 195 | 222 | 293 | 283 |
| Cote d'Ivoire | | | | | | | | | | | | 5 | | | |
| Egypt | 233 | 469 | | | | | | | | | | 168 | | 187 | 234 |
| EU | 131 | 164 | 98 | 105 | 105 | | 34 | 137 | 34 | | 110 | 139 | 116 | 183 | |
| Ghana | | | | | | | | | | | | 6 | | | |
| Guinea | | | | | | | | | | | | 14 | | | |
| Hong Kong | | | | | | | | | | | | 0 | | | |
| India | 110 | 44 | | | | 83 | 17 | 29 | 82 | | | 100 | 101 | | 145 |
| Indonesia | | 121 | | | | | | | | | 80 | 98 | 130 | | 148 |
| Iran | 52 | | | | | | | | | | | 119 | | 124 | 233 |
| Iraq | | | | | | | | | | | | 49 | | | |
| Japan | 68 | 16 | 77 | | | | 14 | 118 | | | 124 | 0 | 145 | 45 | |
| Kazakhstan | | | | | | | | | | | | | | | 87 |
| Kenya | | | | | | | | | | | | 54 | | | |
| Malaysia | | 115 | | | | | | | | | 98 | 138 | | | 150 |
| Mali | | | | | | | | | | | | 27 | | | |
| Mexico | 84 | 95 | 7 | | | 10 | 0 | 58 | | | | 86 | 52 | | 104 |
| Morocco | 29 | | | | | | | | | | | | | 164 | 141 |
| Mozambique | | | | | | | | | | | | 5 | | | |
| Myanmar | | | | | | | | | | | | 7 | | | |
| Nigeria | | | | | | | 1 | | | | | 6 | | | |
| Pakistan | 129 | 137 | 40 | | | 45 | | | | | 104 | 180 | 113 | 186 | |
| Paraguay | | | | | | | 3 | | | | | | | | |
| Philippines | | 39 | | | | | | | | | | 49 | | | 27 |
| Russia | 20 | 66 | 16 | 17 | 18 | | | | | | | | 0 | 103 | |
| Senegal | | | | | | | | | | | | 28 | | | |
| Sierra Leona | | | | | | | | | | | | 3 | | | |
| South Africa | | 55 | 32 | | | 54 | | | | | | 0 | | | 186 |
| South Korea | 59 | 74 | | | | | 15 | | | | 127 | 0 | | | |
| Taiwan | 0 | 85 | | | | | 0 | | | | 109 | 0 | | | |
| Tanzania | | | | | | | | | | | | 9 | | | |
| Thailand | | 61 | | | | | | | | | | 25 | | | 43 |
| Tunisia | 34 | | | | | | | | | | | | | | |
| Turkey | | | | | | | | | | | | 128 | 141 | 90 | |
| U.S. | 74 | 155 | 67 | 56 | | 101 | 4 | 45 | 268 | 47 | | 230 | 60 | 148 | 123 |
| Ukraine | 27 | 73 | 17 | 19 | 18 | | | | 105 | 31 | | | | 100 | |
| Uruguay | | | | | | | | | | | | 65 | | | |
| Uzbekistan | | | | | | | | | | | | | | 184 | |
| Vietnam | | 119 | | | | | | | | | | 104 | | | |
| Colombia | | | | | | | | | | | | | | | 70 |
| Cuba | | | | | | | | | | | | | | | 58 |
| Guatemala | | | | | | | | | | | | | | | 76 |
| Peru | | | | | | | | | | | | | | | 69 |
| Venezuela | | | | | | | | | | | | | | | 113 |
| Africa, Other | 30 | 13 | 13 | 38 | 94 | 1 | 10 | 9 | 21 | 11 | 45 | 1 | 0 | 0 | 29 |
| Americas, Other | 46 | 58 | 126 | 129 | 143 | 139 | 17 | 9 | 123 | 17 | 47 | 76 | 21 | 228 | 101 |
| Asia, Other | 34 | 55 | 32 | 46 | 14 | 53 | 5 | 42 | 70 | 45 | 32 | 88 | 72 | 124 | 202 |
| Europe, Other | 54 | 71 | 27 | 32 | 22 | 0 | 9 | 0 | 11 | 5 | 0 | 69 | 28 | 31 | 0 |
| Oceania, Other | 124 | 141 | 171 | 34 | 43 | 0 | 19 | 13 | 68 | 13 | 59 | 0 | 0 | 0 | 183 |
| World | 80 | 105 | 48 | 53 | 61 | 31 | 11 | 37 | 112 | 28 | 78 | 101 | 120 | 118 | 123 |

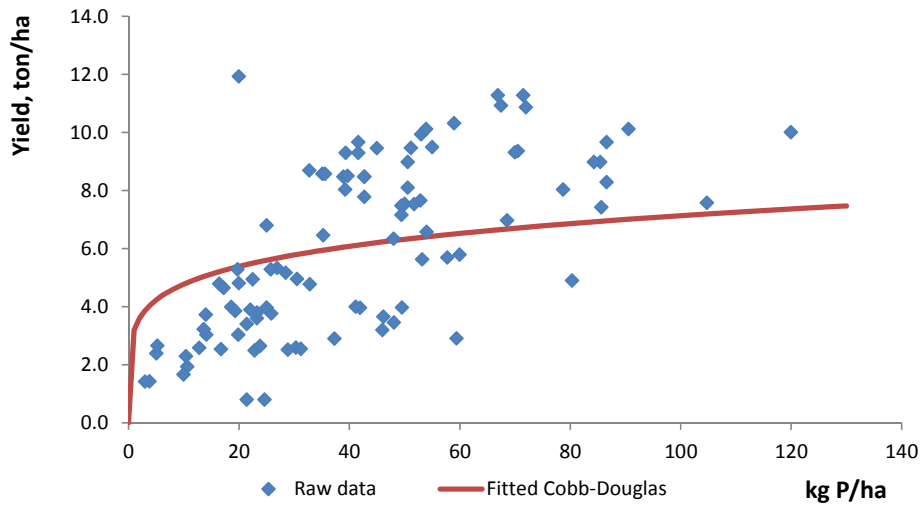
PHOSPHOROUS APPLICATION RATES (KG/HA of nutrients)

| | Wheat, All | Corn | Barley | Oats | Rye | Sorghum | Soybeans | Peanut | Rapeseed | Sunflower Seed | Palm Oil | Rice, All | Cotton | Sugar Beet | Sugar Cane |
|-----------------|------------|------|--------|------|-----|---------|----------|--------|----------|----------------|----------|-----------|--------|------------|------------|
| Africa | | | | | | | | | | | | | 10 | | |
| Algeria | 17 | 25 | 8 | | | | | | | | | | | | |
| Argentina | 30 | 35 | 44 | | | 44 | 15 | 13 | | 7 | | 15 | 2 | | 2 |
| Australia | 23 | 58 | 40 | | | 40 | | | 59 | | | 0 | 45 | | 80 |
| Bangladesh | | | | | | | | | | | | 15 | | | |
| Brazil | 41 | 50 | 26 | | | | 73 | | | | | 50 | 149 | | 45 |
| Cambodia | | | | | | | | | | | | 5 | | | |
| Cameroon | | | | | | | | | | | | 1 | | | |
| Canada | 19 | 40 | 19 | 15 | | | 23 | | 16 | | | 0 | 0 | 18 | |
| China | 81 | 28 | 35 | | | | 41 | 59 | 55 | 27 | | 62 | 79 | 170 | 151 |
| Cote d'Ivoire | | | | | | | | | | | | 2 | | | |
| Egypt | 27 | 36 | | | | | | | | | | 31 | | 29 | 33 |
| EU | 30 | 53 | 34 | 24 | 24 | | 30 | | 35 | 13 | | 41 | 50 | 59 | 80 |
| Ghana | | | | | | | | | | | | 2 | | | |
| Guinea | | | | | | | | | | | | 10 | | | |
| Hong Kong | | | | | | | | | | | | 0 | | | |
| India | 41 | 10 | | | | 36 | 16 | 40 | 25 | | | 33 | 49 | | 51 |
| Indonesia | | 24 | | | | | | | | | 30 | 9 | 77 | | 73 |
| Iran | 22 | | | | | | | | | | | 38 | | 63 | 83 |
| Iraq | | | | | | | | | | | | 21 | | | |
| Japan | 20 | 5 | 72 | | | | 50 | | 216 | | | 52 | 0 | 267 | 18 |
| Kazakhstan | | | | | | | | | | | | 54 | | | |
| Kenya | | | | | | | | | | | | 30 | | | |
| Malaysia | | 48 | | | | | | | | | 34 | 73 | | | 63 |
| Mali | | | | | | | | | | | | 21 | | | |
| Mexico | 10 | 14 | 1 | | | 1 | 48 | 13 | | | | 30 | 27 | | 33 |
| Morocco | 18 | | | | | | | | | | | | | 134 | 62 |
| Mozambique | | | | | | | | | | | | 3 | | | |
| Myanmar | | | | | | | | | | | | 3 | | | |
| Nigeria | | | | | | 0 | | | | | | 2 | | | |
| Pakistan | 25 | 37 | 8 | | | 7 | | | | | | 21 | 33 | 37 | 48 |
| Paraguay | | | | | | | 11 | | | | | | | | |
| Philippines | | 5 | | | | | | | | | | 8 | | | 18 |
| Russia | 8 | 20 | 9 | 2 | 3 | | | | | | | | 0 | 64 | |
| Senegal | | | | | | | | | | | | 21 | | | |
| Sierra Leona | | | | | | | | | | | | 1 | | | |
| South Africa | | 19 | 20 | | | 23 | | | | | | 0 | | | 91 |
| South Korea | 17 | 23 | | | | | 52 | | | | | 53 | 0 | | |
| Taiwan | 0 | 26 | | | | | 0 | | | | | 45 | 0 | | |
| Tanzania | | | | | | | | | | | | 5 | | | |
| Thailand | | 19 | | | | | | | | | | 7 | | | 27 |
| Tunisia | 21 | | | | | | | | | | | | | | |
| Turkey | | | | | | | | | | | | 49 | 52 | 58 | |
| U.S. | 29 | 51 | 16 | 13 | | 23 | 17 | 42 | 121 | 11 | | 40 | 26 | 53 | 53 |
| Ukraine | 10 | 22 | 9 | 3 | 3 | | | | 23 | 37 | | | | 95 | |
| Uruguay | | | | | | | | | | | | 59 | | | |
| Uzbekistan | | | | | | | | | | | | 46 | | | |
| Vietnam | | 41 | | | | | | | | | | 61 | | | |
| Colombia | | | | | | | | | | | | | | | 70 |
| Cuba | | | | | | | | | | | | | | | 40 |
| Guatemala | | | | | | | | | | | | | | | 61 |
| Peru | | | | | | | | | | | | | | | 69 |
| Venezuela | | | | | | | | | | | | | | | 75 |
| Africa, Other | 9 | 3 | 14 | 33 | 106 | 0 | 36 | 6 | 27 | 5 | 27 | 1 | 0 | 0 | 24 |
| Americas, Other | 13 | 31 | 77 | 50 | 21 | 37 | 62 | 23 | 109 | 16 | 29 | 32 | 3 | 104 | 21 |
| Asia, Other | 13 | 17 | 12 | 12 | 2 | 18 | 17 | 13 | 12 | 6 | 19 | 23 | 45 | 34 | 29 |
| Europe, Other | 12 | 21 | 15 | 4 | 4 | 0 | 11 | 0 | 10 | 6 | 0 | 29 | 17 | 16 | 0 |
| Oceania, Other | 36 | 43 | 196 | 24 | 30 | 0 | 69 | 23 | 59 | 23 | 36 | 0 | 0 | 0 | 80 |
| World | 29 | 31 | 21 | 16 | 13 | 12 | 33 | 29 | 34 | 14 | 31 | 31 | 47 | 68 | 52 |

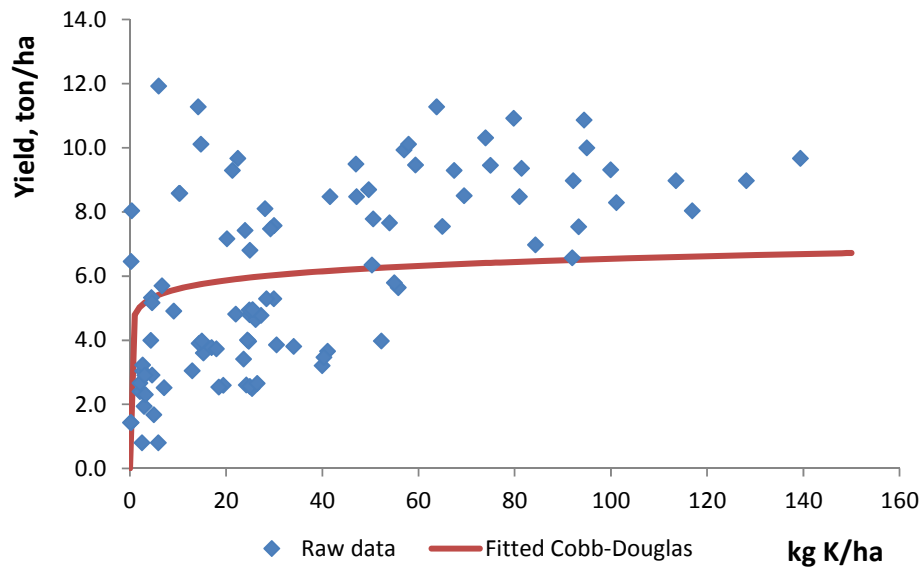
POTASSIUM APPLICATION RATES (KG/HA of nutrients)

| | Wheat, All | Corn | Barley | Oats | Rye | Sorghum | Soybeans | Peanut | Rapeseed | Sunflower Seed | Palm Oil | Rice, All | Cotton | Sugar Beet | Sugar Cane |
|-----------------|------------|------|--------|------|-----|---------|----------|--------|----------|----------------|----------|-----------|--------|------------|------------|
| Africa | | | | | | | | | | | | | 9 | | |
| Algeria | 4 | 3 | 1 | | | | | | | | | | | | |
| Argentina | 0 | 0 | 0 | | | 0 | 0 | 0 | | 0 | | 13 | 0 | | 23 |
| Australia | 2 | 7 | 2 | | | 2 | | | 6 | | | 0 | 14 | | 118 |
| Bangladesh | | | | | | | | | | | | 12 | | | |
| Brazil | 41 | 52 | 22 | | | | 67 | | | | | 54 | 143 | | 122 |
| Cambodia | | | | | | | | | | | | | | | 0 |
| Cameroon | | | | | | | | | | | | | 0 | | |
| Canada | 3 | 70 | 2 | 1 | | | 22 | | 14 | | | 0 | 0 | 93 | |
| China | 10 | 5 | 25 | | | | 7 | 11 | 14 | 14 | | 60 | 13 | 125 | 178 |
| Cote d'Ivoire | | | | | | | | | | | | | | | 0 |
| Egypt | 8 | 10 | | | | | | | | | | 0 | | 21 | 40 |
| EU | 22 | 56 | 28 | 21 | 21 | | 34 | | 54 | 8 | | 73 | 46 | 113 | 118 |
| Ghana | | | | | | | | | | | | | | | 0 |
| Guinea | | | | | | | | | | | | | 8 | | |
| Hong Kong | | | | | | | | | | | | | | | 0 |
| India | 8 | 3 | | | | 8 | 3 | 17 | 4 | | | 21 | 15 | | 53 |
| Indonesia | | 26 | | | | | | | | | 97 | 10 | 43 | | 219 |
| Iran | 6 | | | | | | | | | | | | | 10 | 45 |
| Iraq | | | | | | | | | | | | | | | 20 |
| Japan | 25 | 5 | 74 | | | | 33 | | 107 | | | 51 | 0 | 132 | 12 |
| Kazakhstan | | | | | | | | | | | | | | | 29 |
| Kenya | | | | | | | | | | | | | | | 0 |
| Malaysia | | 40 | | | | | | | | | 223 | 81 | | | 175 |
| Mali | | | | | | | | | | | | | | | 17 |
| Mexico | 4 | 3 | 0 | | | 0 | 31 | 0 | | | | 30 | 18 | | 92 |
| Morocco | 4 | | | | | | | | | | | | | | 59 |
| Mozambique | | | | | | | | | | | | | | | 0 |
| Myanmar | | | | | | | | | | | | | | | 0 |
| Nigeria | | | | | | 0 | | | | | | | | | 0 |
| Pakistan | 1 | 3 | 0 | | | 0 | | | | | | 1 | 1 | 1 | 3 |
| Paraguay | | | | | | | 0 | | | | | | | | |
| Philippines | | 2 | | | | | | | | | | 3 | | | 44 |
| Russia | 3 | 13 | 6 | 1 | 2 | | | | | | | | 0 | 65 | |
| Senegal | | | | | | | | | | | | | 17 | | |
| Sierra Leona | | | | | | | | | | | | | | | 0 |
| South Africa | | 4 | 4 | | | 5 | | | | | | | | | 192 |
| South Korea | 22 | 25 | | | | | 34 | | | | | 52 | 0 | | |
| Taiwan | 0 | 28 | | | | | 0 | | | | | 44 | 0 | | |
| Tanzania | | | | | | | | | | | | | | | 0 |
| Thailand | | 31 | | | | | | | | | | 1 | | | 39 |
| Tunisia | 5 | | | | | | | | | | | | | | |
| Turkey | | | | | | | | | | | | 6 | 9 | 48 | |
| U.S. | 11 | 59 | 4 | 4 | | 14 | 26 | 82 | 97 | 13 | | 41 | 32 | 76 | 279 |
| Ukraine | 4 | 14 | 7 | 1 | 2 | | | | 23 | 11 | | | | | 110 |
| Uruguay | | | | | | | | | | | | | 19 | | |
| Uzbekistan | | | | | | | | | | | | | | 6 | |
| Vietnam | | 24 | | | | | | | | | | 39 | | | |
| Colombia | | | | | | | | | | | | | | | 70 |
| Cuba | | | | | | | | | | | | | | | 83 |
| Guatemala | | | | | | | | | | | | | | | 38 |
| Peru | | | | | | | | | | | | | | | 69 |
| Venezuela | | | | | | | | | | | | | | | 75 |
| Africa, Other | 11 | 0 | 3 | 10 | 18 | 0 | 24 | 5 | 3 | 1 | 70 | 1 | 0 | 0 | 19 |
| Americas, Other | 17 | 25 | 7 | 0 | 19 | 46 | 40 | 19 | 62 | 16 | 74 | 31 | 1 | 278 | 144 |
| Asia, Other | 3 | 18 | 5 | 13 | 2 | 0 | 2 | 5 | 6 | 6 | 49 | 18 | 24 | 35 | 63 |
| Europe, Other | 11 | 24 | 10 | 2 | 2 | 0 | 5 | 0 | 3 | 2 | 0 | 28 | 9 | 31 | 0 |
| Oceania, Other | 46 | 47 | 11 | 3 | 4 | 0 | 45 | 3 | 6 | 3 | 91 | 0 | 0 | 0 | 118 |
| World | 8 | 26 | 11 | 7 | 11 | 4 | 26 | 12 | 22 | 6 | 137 | 25 | 19 | 86 | 92 |

Appendix C: Estimated Cobb-Douglas Production Function for Phosphorous and Potassium



Cobb-Douglas Production Function for Phosphorous



Cobb-Douglas Production Function for Potassium

Appendix D: Projected Fertilizer Use for the World, U.S., China, and India in the Period 2011-2025

World Fertilizer Use

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2023 | 2025 |
|-----------------------|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Fertilizer Use | | | | | | | | | | | | | |
| Corn | | | | | | | | | | | | | |
| | (Thousand Metric Tons) | | | | | | | | | | | | |
| Nitrogen | 16,435 | 16,735 | 16,504 | 16,788 | 16,829 | 16,995 | 17,009 | 17,043 | 17,062 | 17,110 | 17,125 | 17,160 | 17,195 |
| Phosphorous | 4,899 | 5,073 | 5,023 | 5,127 | 5,151 | 5,215 | 5,226 | 5,235 | 5,233 | 5,256 | 5,265 | 5,281 | 5,291 |
| Potassium | 4,284 | 4,508 | 4,511 | 4,628 | 4,679 | 4,770 | 4,812 | 4,826 | 4,822 | 4,864 | 4,882 | 4,915 | 4,931 |
| Barley | | | | | | | | | | | | | |
| Nitrogen | 2,390 | 2,450 | 2,574 | 2,510 | 2,554 | 2,545 | 2,558 | 2,552 | 2,557 | 2,558 | 2,554 | 2,560 | 2,557 |
| Phosphorous | 1,011 | 1,055 | 1,135 | 1,095 | 1,120 | 1,119 | 1,137 | 1,133 | 1,132 | 1,143 | 1,148 | 1,155 | 1,153 |
| Potassium | 486 | 505 | 536 | 525 | 533 | 535 | 540 | 539 | 540 | 544 | 545 | 546 | 545 |
| Oats | | | | | | | | | | | | | |
| Nitrogen | 625 | 650 | 669 | 678 | 668 | 677 | 667 | 675 | 669 | 675 | 672 | 676 | 678 |
| Phosphorous | 186 | 196 | 201 | 203 | 199 | 202 | 198 | 201 | 199 | 203 | 204 | 207 | 209 |
| Potassium | 81 | 85 | 87 | 87 | 86 | 87 | 87 | 88 | 88 | 89 | 89 | 91 | 92 |
| Rye | | | | | | | | | | | | | |
| Nitrogen | 358 | 406 | 437 | 428 | 450 | 449 | 464 | 463 | 476 | 477 | 488 | 501 | 511 |
| Phosphorous | 76 | 87 | 93 | 92 | 96 | 97 | 100 | 100 | 103 | 103 | 106 | 109 | 111 |
| Potassium | 61 | 70 | 75 | 74 | 78 | 78 | 81 | 81 | 83 | 84 | 86 | 89 | 91 |
| Sorghum | | | | | | | | | | | | | |
| Nitrogen | 1,088 | 1,146 | 1,077 | 1,110 | 1,071 | 1,083 | 1,064 | 1,071 | 1,068 | 1,076 | 1,076 | 1,087 | 1,098 |
| Phosphorous | 458 | 478 | 453 | 464 | 450 | 455 | 448 | 451 | 450 | 454 | 454 | 460 | 466 |
| Potassium | 183 | 198 | 185 | 194 | 188 | 191 | 188 | 190 | 189 | 190 | 190 | 191 | 193 |
| Wheat, All | | | | | | | | | | | | | |
| Nitrogen | 17,705 | 17,900 | 18,314 | 18,016 | 18,060 | 18,044 | 18,058 | 18,038 | 18,016 | 17,978 | 17,996 | 17,913 | 17,845 |
| Phosphorous | 6,416 | 6,452 | 6,615 | 6,409 | 6,394 | 6,367 | 6,364 | 6,350 | 6,312 | 6,304 | 6,326 | 6,289 | 6,254 |
| Potassium | 2,159 | 2,233 | 2,240 | 2,180 | 2,185 | 2,183 | 2,188 | 2,183 | 2,172 | 2,167 | 2,166 | 2,149 | 2,114 |
| Soybeans | | | | | | | | | | | | | |
| Nitrogen | 1,438 | 1,435 | 1,419 | 1,414 | 1,417 | 1,418 | 1,423 | 1,427 | 1,430 | 1,432 | 1,434 | 1,433 | 1,434 |
| Phosphorous | 4,436 | 4,444 | 4,407 | 4,413 | 4,441 | 4,456 | 4,481 | 4,500 | 4,523 | 4,549 | 4,579 | 4,657 | 4,715 |
| Potassium | 4,255 | 4,240 | 4,189 | 4,182 | 4,199 | 4,203 | 4,226 | 4,240 | 4,256 | 4,276 | 4,301 | 4,357 | 4,410 |
| Rapeseed | | | | | | | | | | | | | |
| Nitrogen | 3,592 | 3,656 | 3,650 | 3,659 | 3,674 | 3,680 | 3,692 | 3,712 | 3,730 | 3,746 | 3,761 | 3,806 | 3,834 |
| Phosphorous | 1,113 | 1,164 | 1,151 | 1,146 | 1,148 | 1,149 | 1,139 | 1,142 | 1,152 | 1,157 | 1,151 | 1,154 | 1,160 |
| Potassium | 689 | 725 | 716 | 714 | 719 | 723 | 723 | 728 | 736 | 742 | 739 | 750 | 759 |
| Sunflower Seed | | | | | | | | | | | | | |
| Nitrogen | 656 | 669 | 650 | 648 | 647 | 645 | 644 | 643 | 642 | 641 | 639 | 634 | 631 |
| Phosphorous | 334 | 342 | 336 | 336 | 336 | 336 | 336 | 337 | 338 | 338 | 338 | 339 | 339 |
| Potassium | 152 | 155 | 152 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| Peanut | | | | | | | | | | | | | |
| Nitrogen | 837 | 854 | 865 | 877 | 886 | 898 | 907 | 915 | 922 | 924 | 925 | 925 | 923 |
| Phosphorous | 611 | 615 | 619 | 621 | 621 | 622 | 623 | 623 | 622 | 620 | 619 | 613 | 609 |
| Potassium | 247 | 252 | 254 | 255 | 255 | 256 | 257 | 257 | 257 | 257 | 257 | 257 | 257 |
| Palm Kernel | | | | | | | | | | | | | |
| Nitrogen | 1,081 | 1,140 | 1,164 | 1,179 | 1,203 | 1,227 | 1,234 | 1,236 | 1,256 | 1,268 | 1,274 | 1,318 | 1,358 |
| Phosphorous | 424 | 446 | 454 | 460 | 469 | 478 | 481 | 483 | 490 | 495 | 497 | 515 | 530 |
| Potassium | 1,855 | 1,945 | 1,977 | 1,997 | 2,035 | 2,073 | 2,084 | 2,080 | 2,113 | 2,133 | 2,144 | 2,217 | 2,282 |
| Rice, All | | | | | | | | | | | | | |
| Nitrogen | 15,805 | 15,603 | 15,585 | 15,547 | 15,569 | 15,564 | 15,566 | 15,566 | 15,552 | 15,543 | 15,535 | 15,578 | 15,536 |
| Phosphorous | 4,941 | 4,880 | 4,875 | 4,862 | 4,869 | 4,867 | 4,869 | 4,871 | 4,868 | 4,866 | 4,865 | 4,881 | 4,873 |
| Potassium | 3,797 | 3,734 | 3,726 | 3,710 | 3,713 | 3,709 | 3,709 | 3,707 | 3,702 | 3,698 | 3,696 | 3,704 | 3,692 |
| Cotton | | | | | | | | | | | | | |
| Nitrogen | 4,012 | 4,894 | 5,003 | 5,007 | 5,068 | 5,106 | 5,129 | 5,140 | 5,157 | 5,169 | 5,185 | 5,221 | 5,248 |
| Phosphorous | 1,533 | 1,689 | 1,678 | 1,656 | 1,661 | 1,667 | 1,672 | 1,674 | 1,680 | 1,685 | 1,694 | 1,715 | 1,729 |
| Potassium | 653 | 737 | 742 | 726 | 725 | 728 | 727 | 726 | 728 | 730 | 736 | 754 | 762 |
| Sugar Cane | | | | | | | | | | | | | |
| Nitrogen | 2,981 | 3,063 | 3,065 | 3,099 | 3,126 | 3,155 | 3,195 | 3,240 | 3,284 | 3,322 | 3,351 | 3,438 | 3,485 |
| Phosphorous | 1,293 | 1,329 | 1,331 | 1,346 | 1,359 | 1,373 | 1,392 | 1,413 | 1,434 | 1,452 | 1,466 | 1,509 | 1,531 |
| Potassium | 2,381 | 2,455 | 2,458 | 2,492 | 2,521 | 2,553 | 2,595 | 2,644 | 2,692 | 2,734 | 2,766 | 2,868 | 2,923 |
| Sugar Beet | | | | | | | | | | | | | |
| Nitrogen | 567 | 588 | 584 | 585 | 587 | 589 | 591 | 593 | 594 | 595 | 595 | 597 | 598 |
| Phosphorous | 321 | 332 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 337 | 338 | 338 |
| Potassium | 392 | 403 | 398 | 398 | 399 | 400 | 402 | 403 | 403 | 403 | 403 | 402 | 402 |
| Crops, Other | | | | | | | | | | | | | |
| Nitrogen | 32,141 | 32,894 | 33,063 | 33,059 | 33,181 | 33,305 | 33,362 | 33,415 | 33,461 | 33,507 | 33,551 | 33,664 | 33,703 |
| Phosphorous | 13,241 | 13,496 | 13,549 | 13,484 | 13,524 | 13,568 | 13,599 | 13,620 | 13,631 | 13,673 | 13,714 | 13,797 | 13,837 |
| Potassium | 10,602 | 10,885 | 10,877 | 10,909 | 10,985 | 11,072 | 11,135 | 11,168 | 11,208 | 11,270 | 11,315 | 11,457 | 11,533 |
| TOTAL | | | | | | | | | | | | | |
| Nitrogen | 101,708 | 104,081 | 104,621 | 104,605 | 104,990 | 105,381 | 105,562 | 105,729 | 105,877 | 106,021 | 106,161 | 106,510 | 106,632 |
| Phosphorous | 41,291 | 42,077 | 42,251 | 42,047 | 42,168 | 42,305 | 42,399 | 42,468 | 42,504 | 42,636 | 42,762 | 43,017 | 43,145 |
| Potassium | 32,278 | 33,129 | 33,123 | 33,223 | 33,453 | 33,713 | 33,904 | 34,010 | 34,139 | 34,331 | 34,467 | 34,899 | 35,136 |

* Other crops includes roots and tubers, pulses, nuts, rubber, coffee, tea, tobacco, ornamentals, turf, pasture, and forestry. World total fertilizer use projection of other crops is assumed to increase each year at the same rate as the world total nutrient use of the sum of all modeled commodities.

United States Fertilizer Use

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2023 | 2025 |
|-----------------------|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Fertilizer Use | | | | | | | | | | | | | |
| Corn | (Thousand Metric Tons) | | | | | | | | | | | | |
| Nitrogen | 5,100 | 5,235 | 5,280 | 5,421 | 5,482 | 5,543 | 5,539 | 5,562 | 5,586 | 5,596 | 5,584 | 5,633 | 5,663 |
| Phosphorous | 2,142 | 2,202 | 2,223 | 2,285 | 2,315 | 2,347 | 2,352 | 2,365 | 2,378 | 2,386 | 2,383 | 2,408 | 2,421 |
| Potassium | 2,708 | 2,798 | 2,828 | 2,917 | 2,969 | 3,028 | 3,056 | 3,085 | 3,108 | 3,133 | 3,135 | 3,182 | 3,205 |
| Barley | | | | | | | | | | | | | |
| Nitrogen | 78 | 67 | 75 | 75 | 74 | 73 | 71 | 71 | 70 | 69 | 68 | 65 | 66 |
| Phosphorous | 19 | 16 | 18 | 18 | 18 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 |
| Potassium | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Oats | | | | | | | | | | | | | |
| Nitrogen | 33 | 32 | 36 | 35 | 35 | 34 | 33 | 33 | 33 | 32 | 32 | 31 | 31 |
| Phosphorous | 8 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 |
| Potassium | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Sorghum | | | | | | | | | | | | | |
| Nitrogen | 173 | 214 | 207 | 215 | 215 | 218 | 216 | 219 | 220 | 219 | 220 | 224 | 230 |
| Phosphorous | 69 | 85 | 82 | 85 | 85 | 87 | 86 | 87 | 87 | 87 | 88 | 90 | 92 |
| Potassium | 52 | 62 | 60 | 62 | 62 | 63 | 62 | 63 | 63 | 63 | 63 | 65 | 66 |
| Wheat, All | | | | | | | | | | | | | |
| Nitrogen | 1,477 | 1,521 | 1,476 | 1,432 | 1,447 | 1,444 | 1,444 | 1,437 | 1,431 | 1,425 | 1,416 | 1,395 | 1,334 |
| Phosphorous | 709 | 734 | 705 | 680 | 684 | 683 | 684 | 682 | 677 | 674 | 670 | 662 | 630 |
| Potassium | 647 | 690 | 658 | 635 | 640 | 638 | 640 | 637 | 633 | 630 | 626 | 615 | 583 |
| Soybeans | | | | | | | | | | | | | |
| Nitrogen | 555 | 549 | 540 | 539 | 539 | 538 | 542 | 544 | 544 | 546 | 547 | 546 | 551 |
| Phosphorous | 1,630 | 1,605 | 1,578 | 1,571 | 1,569 | 1,563 | 1,571 | 1,575 | 1,576 | 1,578 | 1,582 | 1,577 | 1,590 |
| Potassium | 2,401 | 2,358 | 2,316 | 2,300 | 2,295 | 2,284 | 2,295 | 2,299 | 2,299 | 2,300 | 2,305 | 2,292 | 2,308 |
| Rapeseed | | | | | | | | | | | | | |
| Nitrogen | 160 | 165 | 168 | 169 | 170 | 170 | 171 | 173 | 175 | 176 | 178 | 186 | 193 |
| Phosphorous | 73 | 76 | 77 | 77 | 78 | 78 | 79 | 79 | 80 | 81 | 82 | 85 | 89 |
| Potassium | 57 | 59 | 60 | 60 | 61 | 61 | 61 | 62 | 62 | 63 | 63 | 66 | 69 |
| Sunflower Seed | | | | | | | | | | | | | |
| Nitrogen | 37 | 37 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 37 |
| Phosphorous | 8 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 9 |
| Potassium | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Peanut | | | | | | | | | | | | | |
| Nitrogen | 24 | 25 | 26 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Phosphorous | 23 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Potassium | 43 | 45 | 46 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 44 | 44 | 44 |
| Rice, All | | | | | | | | | | | | | |
| Nitrogen | 314 | 258 | 248 | 249 | 248 | 249 | 249 | 245 | 246 | 248 | 253 | 283 | 272 |
| Phosphorous | 54 | 44 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 43 | 46 |
| Potassium | 54 | 44 | 43 | 43 | 43 | 43 | 43 | 42 | 42 | 42 | 43 | 48 | 47 |
| Cotton | | | | | | | | | | | | | |
| Nitrogen | 424 | 554 | 588 | 566 | 555 | 549 | 547 | 541 | 536 | 536 | 538 | 546 | 549 |
| Phosphorous | 204 | 266 | 283 | 273 | 268 | 267 | 266 | 264 | 263 | 264 | 265 | 269 | 271 |
| Potassium | 229 | 302 | 322 | 311 | 306 | 305 | 305 | 303 | 301 | 301 | 303 | 304 | 303 |
| Sugar Cane | | | | | | | | | | | | | |
| Nitrogen | 41 | 43 | 41 | 39 | 39 | 38 | 38 | 37 | 37 | 37 | 37 | 36 | 36 |
| Phosphorous | 18 | 19 | 18 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| Potassium | 92 | 97 | 94 | 89 | 87 | 87 | 86 | 85 | 84 | 83 | 83 | 82 | 82 |
| Sugar Beet | | | | | | | | | | | | | |
| Nitrogen | 69 | 68 | 61 | 59 | 59 | 58 | 58 | 58 | 58 | 58 | 58 | 59 | 60 |
| Phosphorous | 25 | 24 | 22 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |
| Potassium | 35 | 35 | 31 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 31 |
| Crops, Other | | | | | | | | | | | | | |
| Nitrogen | 3,361 | 3,440 | 3,457 | 3,457 | 3,470 | 3,483 | 3,489 | 3,494 | 3,499 | 3,504 | 3,508 | 3,520 | 3,524 |
| Phosphorous | 889 | 906 | 910 | 905 | 908 | 911 | 913 | 914 | 915 | 918 | 921 | 926 | 929 |
| Potassium | 1,138 | 1,168 | 1,168 | 1,171 | 1,179 | 1,189 | 1,195 | 1,199 | 1,203 | 1,210 | 1,215 | 1,230 | 1,238 |
| TOTAL | | | | | | | | | | | | | |
| Nitrogen | 11,846 | 12,208 | 12,240 | 12,319 | 12,393 | 12,459 | 12,459 | 12,476 | 12,495 | 12,507 | 12,500 | 12,587 | 12,572 |
| Phosphorous | 5,870 | 6,017 | 5,998 | 6,016 | 6,046 | 6,072 | 6,088 | 6,102 | 6,111 | 6,122 | 6,125 | 6,156 | 6,160 |
| Potassium | 7,473 | 7,675 | 7,643 | 7,680 | 7,733 | 7,787 | 7,833 | 7,864 | 7,885 | 7,915 | 7,926 | 7,975 | 7,992 |

China Fertilizer Use

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2023 | 2025 |
|-----------------------|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Fertilizer Use | | | | | | | | | | | | | |
| Corn | (Thousand Metric Tons) | | | | | | | | | | | | |
| Nitrogen | 5,371 | 5,354 | 5,261 | 5,325 | 5,327 | 5,395 | 5,425 | 5,453 | 5,479 | 5,515 | 5,547 | 5,583 | 5,619 |
| Phosphorous | 883 | 887 | 870 | 880 | 881 | 895 | 903 | 907 | 910 | 920 | 928 | 935 | 942 |
| Potassium | 140 | 143 | 140 | 141 | 141 | 145 | 147 | 148 | 148 | 151 | 153 | 155 | 156 |
| Barley | | | | | | | | | | | | | |
| Nitrogen | 55 | 56 | 60 | 56 | 58 | 57 | 57 | 57 | 57 | 57 | 57 | 56 | 55 |
| Phosphorous | 23 | 22 | 23 | 22 | 23 | 22 | 23 | 22 | 23 | 23 | 23 | 23 | 23 |
| Potassium | 16 | 16 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| Wheat, All | | | | | | | | | | | | | |
| Nitrogen | 4,416 | 4,345 | 4,486 | 4,392 | 4,368 | 4,323 | 4,319 | 4,302 | 4,287 | 4,239 | 4,259 | 4,187 | 4,182 |
| Phosphorous | 1,919 | 1,899 | 1,978 | 1,912 | 1,906 | 1,892 | 1,894 | 1,884 | 1,874 | 1,862 | 1,876 | 1,844 | 1,838 |
| Potassium | 248 | 245 | 255 | 247 | 246 | 244 | 245 | 243 | 242 | 240 | 242 | 238 | 237 |
| Soybeans | | | | | | | | | | | | | |
| Nitrogen | 430 | 428 | 421 | 417 | 416 | 414 | 413 | 411 | 411 | 409 | 407 | 396 | 387 |
| Phosphorous | 346 | 343 | 339 | 336 | 335 | 334 | 333 | 331 | 330 | 329 | 327 | 319 | 312 |
| Potassium | 60 | 59 | 58 | 58 | 58 | 57 | 57 | 57 | 57 | 57 | 56 | 55 | 54 |
| Rapeseed | | | | | | | | | | | | | |
| Nitrogen | 1,217 | 1,232 | 1,213 | 1,207 | 1,203 | 1,196 | 1,189 | 1,184 | 1,179 | 1,173 | 1,166 | 1,138 | 1,113 |
| Phosphorous | 393 | 411 | 398 | 397 | 396 | 397 | 389 | 387 | 388 | 386 | 380 | 370 | 361 |
| Potassium | 102 | 107 | 104 | 103 | 103 | 103 | 101 | 101 | 101 | 100 | 99 | 96 | 94 |
| Sunflower Seed | | | | | | | | | | | | | |
| Nitrogen | 97 | 94 | 90 | 89 | 89 | 89 | 88 | 88 | 87 | 87 | 86 | 83 | 81 |
| Phosphorous | 24 | 24 | 23 | 23 | 23 | 22 | 22 | 22 | 22 | 22 | 22 | 21 | 21 |
| Potassium | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 |
| Peanut | | | | | | | | | | | | | |
| Nitrogen | 476 | 486 | 491 | 500 | 508 | 517 | 523 | 528 | 532 | 531 | 530 | 521 | 513 |
| Phosphorous | 265 | 264 | 262 | 262 | 261 | 260 | 259 | 257 | 255 | 252 | 249 | 240 | 232 |
| Potassium | 51 | 51 | 50 | 50 | 50 | 50 | 50 | 49 | 49 | 48 | 48 | 46 | 45 |
| Rice, All | | | | | | | | | | | | | |
| Nitrogen | 5,716 | 5,584 | 5,569 | 5,507 | 5,498 | 5,466 | 5,448 | 5,430 | 5,403 | 5,373 | 5,350 | 5,301 | 5,227 |
| Phosphorous | 1,836 | 1,794 | 1,789 | 1,769 | 1,766 | 1,756 | 1,750 | 1,744 | 1,736 | 1,726 | 1,719 | 1,703 | 1,679 |
| Potassium | 1,726 | 1,686 | 1,682 | 1,663 | 1,660 | 1,650 | 1,645 | 1,640 | 1,631 | 1,622 | 1,615 | 1,600 | 1,578 |
| Cotton | | | | | | | | | | | | | |
| Nitrogen | 1,312 | 1,889 | 2,157 | 2,161 | 2,196 | 2,204 | 2,217 | 2,219 | 2,223 | 2,222 | 2,220 | 2,216 | 2,216 |
| Phosphorous | 420 | 481 | 489 | 482 | 484 | 486 | 488 | 489 | 490 | 490 | 489 | 488 | 488 |
| Potassium | 69 | 79 | 80 | 79 | 80 | 80 | 80 | 80 | 81 | 81 | 80 | 80 | 80 |
| Sugar Cane | | | | | | | | | | | | | |
| Nitrogen | 504 | 508 | 509 | 511 | 512 | 515 | 517 | 520 | 522 | 524 | 527 | 533 | 537 |
| Phosphorous | 269 | 271 | 272 | 273 | 273 | 275 | 276 | 277 | 279 | 280 | 281 | 284 | 287 |
| Potassium | 318 | 321 | 321 | 322 | 323 | 325 | 326 | 328 | 329 | 331 | 332 | 336 | 339 |
| Sugar Beet | | | | | | | | | | | | | |
| Nitrogen | 76 | 86 | 89 | 90 | 90 | 90 | 90 | 90 | 90 | 89 | 89 | 88 | 87 |
| Phosphorous | 44 | 50 | 51 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 51 | 51 |
| Potassium | 32 | 36 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 37 | 37 |
| Crops, Other | | | | | | | | | | | | | |
| Nitrogen | 13,047 | 13,352 | 13,421 | 13,419 | 13,469 | 13,519 | 13,543 | 13,564 | 13,583 | 13,601 | 13,619 | 13,665 | 13,681 |
| Phosphorous | 5,674 | 5,784 | 5,807 | 5,779 | 5,796 | 5,815 | 5,828 | 5,837 | 5,842 | 5,860 | 5,877 | 5,913 | 5,930 |
| Potassium | 3,531 | 3,625 | 3,622 | 3,633 | 3,658 | 3,687 | 3,708 | 3,719 | 3,733 | 3,753 | 3,768 | 3,815 | 3,841 |
| TOTAL | | | | | | | | | | | | | |
| Nitrogen | 32,717 | 33,413 | 33,768 | 33,675 | 33,734 | 33,784 | 33,828 | 33,846 | 33,853 | 33,821 | 33,857 | 33,767 | 33,698 |
| Phosphorous | 12,096 | 12,229 | 12,301 | 12,185 | 12,196 | 12,206 | 12,216 | 12,212 | 12,200 | 12,200 | 12,223 | 12,190 | 12,163 |
| Potassium | 6,305 | 6,380 | 6,379 | 6,362 | 6,386 | 6,408 | 6,425 | 6,431 | 6,436 | 6,449 | 6,461 | 6,487 | 6,488 |

India Fertilizer Use

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2023 | 2025 |
|-----------------------|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Fertilizer Use | | | | | | | | | | | | | |
| Corn | (Thousand Metric Tons) | | | | | | | | | | | | |
| Nitrogen | 354 | 369 | 342 | 339 | 329 | 324 | 318 | 315 | 312 | 311 | 309 | 302 | 299 |
| Phosphorous | 79 | 82 | 75 | 72 | 68 | 66 | 64 | 64 | 63 | 63 | 63 | 61 | 60 |
| Potassium | 22 | 22 | 19 | 18 | 15 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 |
| Sorghum | | | | | | | | | | | | | |
| Nitrogen | 578 | 584 | 559 | 562 | 540 | 541 | 528 | 531 | 532 | 538 | 536 | 543 | 548 |
| Phosphorous | 251 | 254 | 243 | 244 | 235 | 235 | 229 | 231 | 231 | 234 | 233 | 236 | 238 |
| Potassium | 58 | 59 | 56 | 57 | 54 | 55 | 53 | 54 | 54 | 54 | 54 | 55 | 55 |
| Wheat, All | | | | | | | | | | | | | |
| Nitrogen | 3,131 | 3,105 | 3,266 | 3,191 | 3,221 | 3,223 | 3,242 | 3,252 | 3,260 | 3,272 | 3,284 | 3,318 | 3,336 |
| Phosphorous | 1,093 | 1,053 | 1,088 | 1,020 | 1,002 | 977 | 959 | 960 | 960 | 964 | 968 | 979 | 984 |
| Potassium | 203 | 196 | 202 | 189 | 186 | 181 | 178 | 178 | 178 | 179 | 180 | 182 | 183 |
| Soybeans | | | | | | | | | | | | | |
| Nitrogen | 158 | 159 | 158 | 158 | 158 | 159 | 160 | 161 | 162 | 162 | 162 | 162 | 163 |
| Phosphorous | 153 | 154 | 153 | 153 | 154 | 155 | 156 | 156 | 157 | 157 | 157 | 158 | 159 |
| Potassium | 28 | 29 | 28 | 28 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 |
| Rapeseed | | | | | | | | | | | | | |
| Nitrogen | 539 | 546 | 560 | 567 | 571 | 575 | 579 | 584 | 590 | 596 | 602 | 620 | 635 |
| Phosphorous | 154 | 158 | 159 | 157 | 154 | 152 | 150 | 150 | 152 | 154 | 155 | 160 | 164 |
| Potassium | 23 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 23 | 23 | 24 | 24 | 25 |
| Peanut | | | | | | | | | | | | | |
| Nitrogen | 176 | 180 | 185 | 187 | 188 | 190 | 192 | 194 | 196 | 197 | 199 | 204 | 208 |
| Phosphorous | 241 | 244 | 249 | 251 | 252 | 254 | 256 | 258 | 258 | 259 | 260 | 263 | 265 |
| Potassium | 104 | 105 | 108 | 108 | 109 | 110 | 110 | 111 | 111 | 112 | 112 | 113 | 114 |
| Rice, All | | | | | | | | | | | | | |
| Nitrogen | 4,370 | 4,357 | 4,355 | 4,363 | 4,378 | 4,385 | 4,393 | 4,403 | 4,412 | 4,418 | 4,428 | 4,463 | 4,474 |
| Phosphorous | 1,444 | 1,440 | 1,440 | 1,442 | 1,447 | 1,450 | 1,452 | 1,455 | 1,459 | 1,461 | 1,464 | 1,475 | 1,479 |
| Potassium | 870 | 868 | 868 | 869 | 872 | 873 | 875 | 877 | 879 | 880 | 882 | 889 | 891 |
| Cotton | | | | | | | | | | | | | |
| Nitrogen | 1,063 | 1,152 | 980 | 982 | 992 | 1,007 | 1,011 | 1,015 | 1,019 | 1,023 | 1,026 | 1,021 | 1,023 |
| Phosphorous | 532 | 559 | 539 | 534 | 535 | 538 | 540 | 542 | 544 | 546 | 548 | 545 | 546 |
| Potassium | 163 | 171 | 165 | 163 | 164 | 165 | 165 | 166 | 167 | 167 | 168 | 167 | 167 |
| Sugar Cane | | | | | | | | | | | | | |
| Nitrogen | 700 | 730 | 733 | 739 | 742 | 746 | 752 | 758 | 765 | 770 | 774 | 788 | 798 |
| Phosphorous | 246 | 257 | 258 | 260 | 261 | 263 | 265 | 267 | 269 | 271 | 273 | 278 | 281 |
| Potassium | 254 | 265 | 266 | 268 | 269 | 271 | 273 | 275 | 278 | 280 | 281 | 286 | 290 |
| Crops, Other | | | | | | | | | | | | | |
| Nitrogen | 3,703 | 3,790 | 3,809 | 3,809 | 3,823 | 3,837 | 3,844 | 3,850 | 3,855 | 3,860 | 3,865 | 3,878 | 3,883 |
| Phosphorous | 1,530 | 1,560 | 1,566 | 1,559 | 1,563 | 1,568 | 1,572 | 1,574 | 1,575 | 1,580 | 1,585 | 1,595 | 1,599 |
| Potassium | 905 | 929 | 928 | 931 | 937 | 945 | 950 | 953 | 956 | 962 | 965 | 977 | 984 |
| TOTAL | | | | | | | | | | | | | |
| Nitrogen | 14,770 | 14,972 | 14,946 | 14,897 | 14,942 | 14,987 | 15,018 | 15,062 | 15,103 | 15,146 | 15,185 | 15,301 | 15,366 |
| Phosphorous | 5,725 | 5,761 | 5,770 | 5,693 | 5,672 | 5,657 | 5,643 | 5,657 | 5,669 | 5,689 | 5,706 | 5,750 | 5,776 |
| Potassium | 2,631 | 2,667 | 2,664 | 2,656 | 2,659 | 2,665 | 2,670 | 2,679 | 2,688 | 2,699 | 2,708 | 2,736 | 2,752 |

Appendix E: Projected Fertilizer Application Rates for China in the period 2011-2025

China Fertilizer Use

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|----------------------------|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Rate of Application | (Kilograms per Hectare) | | | | | | | | | | | | | | | |
| Corn | | | | | | | | | | | | | | | | |
| Nitrogen | 170.52 | 171.25 | 171.12 | 171.05 | 171.07 | 171.45 | 171.69 | 171.68 | 171.55 | 171.90 | 172.20 | 172.15 | 172.27 | 172.33 | 172.40 | 172.42 |
| Phosphorous | 28.04 | 28.37 | 28.31 | 28.28 | 28.29 | 28.46 | 28.57 | 28.56 | 28.51 | 28.67 | 28.80 | 28.78 | 28.84 | 28.86 | 28.90 | 28.90 |
| Potassium | 4.43 | 4.57 | 4.55 | 4.53 | 4.54 | 4.61 | 4.65 | 4.65 | 4.63 | 4.69 | 4.75 | 4.74 | 4.77 | 4.78 | 4.79 | 4.80 |
| Barley | | | | | | | | | | | | | | | | |
| Nitrogen | 78.86 | 78.51 | 78.10 | 77.91 | 77.97 | 78.01 | 78.12 | 78.09 | 78.15 | 78.40 | 78.57 | 78.67 | 78.68 | 78.80 | 78.86 | 78.93 |
| Phosphorous | 32.31 | 31.52 | 30.62 | 30.21 | 30.33 | 30.43 | 30.65 | 30.58 | 30.71 | 31.25 | 31.63 | 31.86 | 31.87 | 32.14 | 32.28 | 32.45 |
| Potassium | 23.08 | 22.51 | 21.87 | 21.58 | 21.66 | 21.73 | 21.89 | 21.84 | 21.94 | 22.32 | 22.59 | 22.76 | 22.77 | 22.96 | 23.06 | 23.18 |
| Wheat, All | | | | | | | | | | | | | | | | |
| Nitrogen | 181.73 | 181.83 | 181.98 | 181.76 | 181.81 | 181.86 | 181.89 | 181.88 | 181.83 | 181.92 | 181.97 | 181.97 | 181.96 | 181.97 | 181.96 | 181.93 |
| Phosphorous | 78.98 | 79.48 | 80.22 | 79.12 | 79.36 | 79.61 | 79.75 | 79.68 | 79.47 | 79.88 | 80.17 | 80.15 | 80.13 | 80.13 | 80.12 | 79.97 |
| Potassium | 10.20 | 10.27 | 10.36 | 10.22 | 10.25 | 10.28 | 10.30 | 10.29 | 10.27 | 10.32 | 10.36 | 10.35 | 10.35 | 10.35 | 10.35 | 10.33 |
| Soybeans | | | | | | | | | | | | | | | | |
| Nitrogen | 51.15 | 51.39 | 51.21 | 50.97 | 50.96 | 51.04 | 51.00 | 51.02 | 51.11 | 51.16 | 51.08 | 51.07 | 51.07 | 51.07 | 51.06 | 51.05 |
| Phosphorous | 41.13 | 41.19 | 41.15 | 41.09 | 41.09 | 41.11 | 41.10 | 41.10 | 41.12 | 41.14 | 41.12 | 41.11 | 41.11 | 41.11 | 41.11 | 41.11 |
| Potassium | 7.08 | 7.09 | 7.09 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 | 7.08 |
| Rapeseed | | | | | | | | | | | | | | | | |
| Nitrogen | 168.97 | 169.65 | 169.33 | 169.35 | 169.39 | 169.52 | 169.28 | 169.25 | 169.38 | 169.40 | 169.20 | 169.15 | 169.13 | 169.12 | 169.11 | 169.12 |
| Phosphorous | 54.54 | 56.65 | 55.61 | 55.68 | 55.79 | 56.21 | 55.45 | 55.35 | 55.77 | 55.83 | 55.20 | 55.03 | 54.98 | 54.93 | 54.90 | 54.93 |
| Potassium | 14.18 | 14.73 | 14.45 | 14.47 | 14.50 | 14.61 | 14.41 | 14.39 | 14.50 | 14.51 | 14.35 | 14.30 | 14.29 | 14.28 | 14.27 | 14.28 |
| Sunflower Seed | | | | | | | | | | | | | | | | |
| Nitrogen | 104.17 | 103.38 | 101.95 | 101.65 | 101.40 | 101.23 | 100.93 | 100.74 | 100.66 | 100.54 | 100.28 | 100.24 | 100.19 | 100.15 | 100.09 | 100.03 |
| Phosphorous | 26.33 | 26.13 | 25.77 | 25.69 | 25.63 | 25.59 | 25.51 | 25.46 | 25.44 | 25.41 | 25.35 | 25.34 | 25.32 | 25.31 | 25.30 | 25.28 |
| Potassium | 13.69 | 13.58 | 13.40 | 13.36 | 13.32 | 13.30 | 13.26 | 13.24 | 13.23 | 13.21 | 13.18 | 13.17 | 13.16 | 13.16 | 13.15 | 13.14 |
| Peanut | | | | | | | | | | | | | | | | |
| Nitrogen | 108.23 | 112.04 | 114.89 | 117.87 | 121.09 | 124.74 | 127.56 | 130.40 | 133.16 | 135.18 | 136.57 | 138.05 | 139.58 | 141.18 | 142.73 | 144.29 |
| Phosphorous | 60.31 | 60.89 | 61.31 | 61.75 | 62.21 | 62.72 | 63.11 | 63.49 | 63.86 | 64.12 | 64.31 | 64.50 | 64.69 | 64.90 | 65.09 | 65.29 |
| Potassium | 11.58 | 11.69 | 11.77 | 11.85 | 11.94 | 12.04 | 12.11 | 12.19 | 12.26 | 12.31 | 12.34 | 12.38 | 12.42 | 12.46 | 12.49 | 12.53 |
| Rice, All | | | | | | | | | | | | | | | | |
| Nitrogen | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 | 192.34 |
| Phosphorous | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 | 61.79 |
| Potassium | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 | 58.07 |
| Cotton | | | | | | | | | | | | | | | | |
| Nitrogen | 257.23 | 338.71 | 388.73 | 396.45 | 401.68 | 401.87 | 401.87 | 401.87 | 401.87 | 401.87 | 401.87 | 401.87 | 401.87 | 401.87 | 401.87 | 401.87 |
| Phosphorous | 82.30 | 86.20 | 88.10 | 88.36 | 88.53 | 88.54 | 88.54 | 88.54 | 88.54 | 88.54 | 88.54 | 88.54 | 88.54 | 88.54 | 88.54 | 88.54 |
| Potassium | 13.54 | 14.18 | 14.50 | 14.54 | 14.57 | 14.57 | 14.57 | 14.57 | 14.57 | 14.57 | 14.57 | 14.57 | 14.57 | 14.57 | 14.57 | 14.57 |
| Sugar Cane | | | | | | | | | | | | | | | | |
| Nitrogen | 283.40 | 283.53 | 283.59 | 283.72 | 283.84 | 283.97 | 284.07 | 284.16 | 284.26 | 284.32 | 284.32 | 284.32 | 284.33 | 284.32 | 284.30 | 284.28 |
| Phosphorous | 151.21 | 151.28 | 151.31 | 151.38 | 151.45 | 151.51 | 151.57 | 151.61 | 151.67 | 151.70 | 151.70 | 151.70 | 151.71 | 151.70 | 151.69 | 151.68 |
| Potassium | 178.83 | 178.91 | 178.94 | 179.03 | 179.10 | 179.18 | 179.25 | 179.30 | 179.37 | 179.41 | 179.41 | 179.41 | 179.41 | 179.41 | 179.40 | 179.38 |
| Sugar Beet | | | | | | | | | | | | | | | | |
| Nitrogen | 293.64 | 293.87 | 293.94 | 294.05 | 294.14 | 294.23 | 294.30 | 294.37 | 294.45 | 294.52 | 294.56 | 294.58 | 294.61 | 294.62 | 294.63 | 294.64 |
| Phosphorous | 169.84 | 170.08 | 170.15 | 170.27 | 170.37 | 170.46 | 170.53 | 170.61 | 170.69 | 170.76 | 170.81 | 170.83 | 170.86 | 170.87 | 170.88 | 170.89 |
| Potassium | 124.79 | 124.97 | 125.02 | 125.11 | 125.18 | 125.25 | 125.30 | 125.36 | 125.42 | 125.47 | 125.50 | 125.52 | 125.54 | 125.55 | 125.56 | 125.56 |