Towards Developing a Competitive Fertilizer Marketing and Distribution Network in Ukraine

Prepared by

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Acronym List

IFDC	International Fertilizer Development Center
CNFA	Citizen's Network for Foreign Affairs
UHR	Hryunia - Official Currency of Ukraine
JSC	Joint Stock Company
MOAIC	Ministry of Agroindustrial Complex (formerly Ministry of Agriculture and Food)
NGO	Nongovernment Organization
FSU	Former Soviet Union
UNADP	Ukraine National Agricultural Development Plan
GOU	Government of Ukraine
MOAF	Ministry of Agriculture and Food
MOI	Ministry of Industry
IMP	International Monetary Fund
USAID	United States Agency for International Development
USCC	Ukrainian State Chemical Commission

Miscellaneous

EUP	Experimental use period
GDP	Gross domestic product
LOA	Length overall
m	meter
mt	metric ton
mtpy	metric ton per year
ha	hectare
mm^3	normal cubic meters
Mmm^3	1000 normal cubic meters
VAT	Value added tax

Fertilizers

AN	Ammonium nitrate
CPC	Crop protection chemicals
DAP	Diammonium phosphate
MAP	Monoammonium phosphate
K	Potassium
K_2O	Potassium, expressed as potassium oxide
N	Nitrogen
NPK	Compound fertilizer containing three primary nutrients: N, P_2O_5, and K_2O
P	Phosphate
P_2O_5	Phosphate, expressed as phosphorus peptoxide
SSP	Single superphosphate
TSP	Triple superphosphate
UAN	Urea-ammonium nitrate solution

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1.0 Introduction

1.1 Background

The Ukrainian economy and agriculture are mired in the outfall from the political and economic upheaval following breakup of the Soviet Union, independence, and abortive moves toward a market economy. Agriculture and the fertilizer sector have been negatively impacted particularly hard and recovery has been limited to date. Experience in other transitional economies has demonstrated that the harnessing of competitive forces through open markets hold substantial promise for providing the impetus for recovery and subsequent development. Fundamental to success in using competitive markets for recovery and development is the identification of the barriers and constraints that must be removed, relaxed, or overcome in order to give the strategy its high probability of success. Toward this end the United States Agency for International Development (USAID), through the Citizen's Network for Foreign Affairs Inc. (CNFA), provided financial support for a study directed towards identification of barriers and constraints on fertilizer sector recovery and development of strategic considerations for overcoming the same.

1.2 Purpose

The purpose of this study was to describe the fertilizer sector in Ukraine with reference to ownership, management, production, marketing, and distribution of different kinds of fertilizer and outline activities that should be undertaken to develop a private, market-driven fertilizer industry.

1.3 Objectives

The original objectives of the study as outlined in the Terms of Reference were to (1) develop an approach that would rationalize the fertilizer sector created under a paradigm that is no longer valid, (2) identify policy reform areas, and (3) articulate donor assistance needs that would accelerate domestic consumption supplied through a privatized system.

1.4 Study Process

A four-member team of IFDC employees was fielded in September 1997 for one month. The team consisted of a policy economist and team leader (Dr. Thomas H. Foster), a marketing specialist (C. John Currelly), a distribution specialist (Thomas A. Bayley), and a fertilizer production specialist (James W. Foster). A program advisor (N. Martynuik) was employed to facilitate and provide coordination for full support of the team's study activities. To ensure that an appropriate agricultural perspective was maintained and to assist in validation of the information collected, the services of two agricultural advisors, Dr. E. H. Dehodiuk and Dr. M. Koslov, were retained.

Once the mission was in-country, discussions with USAID led to a shifting of the emphasis to more fact-finding in nature. Particular stress was to be placed on (1) validating available information on fertilizer production, use, and exports; (2) assessing the quality of materials delivered and the level of sophistication in use; (3) determining the extent to which the original (Soviet era) distribution system remains intact; and (4) identifying points in the sector offering the greatest opportunities for fostering evolution of a private, market-driven fertilizer system.

Data and observations were collected through interviews with representatives of a broad array of private enterprises, Government of Ukraine (GOU) agencies, parastatal ventures, non-government organizations (NGOs), and donor organizations actively involved in the fertilizer industry and the agroindustrial complex. (A list of those interviewed is contained in **Appendix I**). In addition, field visits were made to and interviews conducted with a sample of private farmers and managers of state farms. Information collected was evaluated preliminarily in team review sessions and issues and/or tentative conclusions drawn were marked for subsequent followup and confirmation. A debriefing of tentative findings and conclusions was held with CNFA and USAID prior to the team's departure. Individual members analyzed data relative to their respective areas of expertise and these findings were integrated into this summary report at IFDC Headquarters.

1.5 Difficulties Encountered

The major difficulty encountered was the lack of cooperation by the GOU authorities and managers of state-owned or state-directed enterprises directly involved in the production and

distribution of fertilizer. Interviews were bureaucratically "stonewalled" and refused and, when granted, little hard data of substance were divulged. This lack of cooperation hampered efforts in fertilizer production sections of the study in particular.

1.6 Report Format

The general fertilizer situation as evaluated is presented as a narrative in Chapter 2. This is done to facilitate reading and allow for communication of the "feel" for the situation developed by the team. Observations and issues of particular relevance for delineating appropriate strategies for fostering a private, market-driven fertilizer system are presented in Chapter 3 along with responses to specific items in the Terms of Reference. Recommendations are presented in Chapter 4.

Similar data series were collected from several different sources. Information not utilized in the text is archived for future use.

2.0 The Current Situation

The purpose of this chapter is to describe the fertilizer situation in Ukraine. Emphasis is placed on describing the industry with respect to production, distribution, and use. To ensure proper context for description of the sector, brief reviews of the resource base, developments in Ukraine agriculture, and the policy environment are included.

2.1 Resource Base

Ukraine has a rich history in agriculture; it was often described as the "breadbasket" of the former Soviet Union (FSU). The production base is significant. Ukraine occupies a total of 60.4 million ha of which agricultural land accounts for approximately 70% (43.0 million ha). With arable or tillable land accounting for 80% (34.3 million ha) of agricultural land, a large portion (57%) of which are the famous black soils or "chernozems," it is readily apparent why Ukraine's agricultural production potential is the envy of Europe **(Table 1)**.

Black soils are a unique land resource and Ukraine reportedly possesses 26% of the world's total. These soils are glacial in origin, developed under forests and grassland, and have a humus-enriched layer that extends in some cases to 1.5 m in depth (**Table 2**). In general, the humus content of the root zone (20-40 cm) averages 4% and has been known to register 8% in some locations. The soils are not only inherently fertile but are also responsive to appropriate applications of organic and inorganic fertilizers and soil amendments. A large portion of the land is of a moderate-to-gently rolling topography, which permits up to 75%-80% of the land to be cultivated in all but the Carpathian Mountain region. In general, topography and the widespread availability of quality soil resources have been key to the extensive mechanization of Ukrainian agriculture **[E. Dehodiuk, personal communication, 1997]**.

From an agroenvironmental perspective, Ukraine enjoys a favorable climate for crop production. The three soil-climatic zones (Forest, Forest-Steppe, and Steppe), which generally spread across Ukraine in belts running from southwest to northeast, are oriented from the northwest to the south-southeast, respectively. The Forest Zone has the shortest growing season, 150-160 frost-free

days, and the highest precipitation (600-700 mm). Moving to the south-southeast the frost-free period increases to 160-170 days in the Forest-Steppe and to 200 days in the Steppe (eastern) and Crimea. Precipitation decreases in the northwest to southeast pattern with the Forest-Steppe and Steppe averaging 450-600 mm and 350-450 mm, respectively. Considering the latitude, temperature ranges are satisfactory for winter wheat production and spring sown crops (including maize) with appropriate cultivar selection [**personal communications with M. Koslov and E. Dehodiuk** and **Appendix VI, Table 1**].

In summary, the resource endowment of Ukraine is fully adequate to support a highly productive and technically aggressive agriculture that could provide a solid base for the evolution of a market-driven agroindustrial complex.

2.2 Agricultural Production

Agricultural production in Ukraine has a relatively narrow crop base with seven or eight crops accounting for about 75% of aggregate production and fertilizer use. Grain dominates crop production and winter wheat is the most important grain crop by a large margin when viewed either from an area or a production perspective (**Tables 3 and 4**). The pattern of production reflects agroclimatic conditions and the role Ukraine was expected to play in the total food and fiber sector of the FSU's command economy. This perspective of Ukraine's agricultural economy has important implications for shifts from a command-driven economic system to evolution of a market economy system.

The five-year period (1985-90) preceding the independence of December 1991 represented the highest level of production intensity, gross agricultural production, and crop yields for the major crops (**Tables 3-5**). The period has been characterized as "Ukrainian agriculture's most productive period" and provides an excellent benchmark for contrasting developments since independence **[M. Koslov, personal communication, 1997]**. Casual inspection of area, production, and yield statistics from 1992 through 1996 reveals that, in general, all measures reveal distinct negative or downward trends although there is significant year-to-year variation. By some measures this post independence production decline approaches 40% to 45%. There are several contributors to this

decline not the least of which is the protracted period of economic turmoil that accompanied independence and collapse of the command system. At the farm level, the reduced availability of fertilizers, fuel and lubricants, spares, and commercial credit and the disruption of output markets all contribute to the decline in production. However, there is limited evidence and a considerable body of expert opinion that Ukraine agriculture has absorbed the initial shock and is poised to make a recovery when favorable conditions return. The relevant question is "Recovery to What?"

2.3 Impacts of Demand and Supply Adjustments

The current structure, organization, and operation of Ukraine's agroindustrial complex, though in transition, is still oriented toward a set of supply and demand conditions that is no longer valid. Dissolution of the East European block and the breakup of the FSU have vastly altered the "market." Deterioration of economic conditions, both domestically and among its former trading partners, has resulted in significantly reduced demand. Likewise, supply processes for production inputs and factors of production have been disrupted and in many cases dismantled. The reality is that the Ukraine no longer has the command and control system to rationalize supply and demand and the rudiment of a market that has evolved is not yet sufficient to be a full substitute for the previous authoritarian system.

When viewed in the context of the old set of supply and demand conditions, available information suggests that there currently is considerable excess of agricultural capacity existing in Ukraine. In addition, the post-harvest assembly, storage, handling, processing and transportation infrastructure in place evolved under supply and demand conditions that are no longer valid. New supply and demand conditions are still unknown, and there is no mechanism in place that allow the new supply and demand conditions to be manifest and provide the market signals (efficient relative prices) to guide the needed economic adjustment. Economic adjustment to shifts in domestic demand and to capitalize on international market opportunities will not only require reallocation and organization of production resources but also development of the downstream infrastructure.

2.4 The Economic and Policy Environment

The Ukraine policy environment is in a state of flux. Due in large part to pressure from donors, only broad macroeconomic policy goals have been articulated and these are being pursued with varying levels of rigor and resolve. Policy goals for specific sectors or subsectors, such as agriculture, are not discernible.

Indicators suggest that macroeconomic policy has made significant strides in monetary reform by bringing inflation under control and developing a measure of confidence in the monetary system. Reports suggest fiscal policy progress leaves much to be desired. Some close observers suggest that some of the apparent gains in fiscal control are due to "wage arrears;" many workers simply have not been paid — some wages are reported to be in arrears for up to 16 months. There is also evidence there is an emerging tendency to try to shift state fiscal responsibilities to the regional and district levels. On the revenue side of fiscal reform and budget control, revenue generating mechanisms have to be characterized as an unarticulated system of predatory taxes and tariffs. Economic conditions, in conjunction with the tax disincentives, have given rise to a shadow economy that is estimated to account for 50% to 60% of the gross domestic product (GDP). Attempts to raise revenue from only the transparent portion of the economy provide a strong incentive for even more of the economy to be diverted underground. The result is an undercapitalized and undermonetized economy with a lack of convertibility to currency. Ukraine is effectively a barter economy with the attendant high transaction costs and distorted relative prices.

In terms of establishing and fostering an open market, policy on the appropriate role of government is yet to be established and articulated. The privatization process has begun, but it is abundantly clear that government at all levels — federal, region (oblast), and district (raion) — is still a dominant force in resource use, production, and marketing decisions. This is especially apparent in the agroindustrial complex. Policymakers treat this complex as a strategic sector in which they are very reluctant to relinquish control to market forces. The numerous examples of embargoes on international and interadministrative unit grain trade, regulatory and licensing "stonewalling," and outright police actions to secure grain or prevent movement of custom harvesters underscore the pervasive extent of state control in the complex. This is compounded by the fact that policy is reactive

rather than proactive, may be imposed retroactively, and is often onerous and confiscatory. Basically, the current policy environment is that which had evolved (or deteriorated to) under the command system. The net effect is that the emergence of an open market and integration into the global economy is being effectively stalled.

This environment injects an inordinate degree of risk into agroindustrial complex business decisions, which stifles entrepreneurship and reduces investment below the levels that the quantity and quality of Ukraine's agricultural resources justify.

2.5 The Distribution System

Available information suggests that the state still dominates fertilizer distribution in Ukraine, accounting for at least 90%-93% of the total amount of the fertilizer distributed. Private distribution is beginning to emerge as a competitive alternative in isolated areas, but growth is severely limited by the poor financial position of most farms, the shortage of cash and commercial credit, and the anti-open market stance of the state. The lack of a land market or a system for collateralization of land and the high risks associated with private in-kind liens is a major constraint to a more rapid evolution of a competitive fertilizer market.

The segment of Ukragrokhim that distributes fertilizer and crop protection chemicals (CPCs) has recently (August 1997) been "privatized" as a state joint stock company (JSC), "Agrokhimcentre." Agrokhimcentre's chairman left little doubt that this JSC is still very much under state control when he stated "Agrokhimcentre will be a commercial structure under the control of Ukragrokhim, which is an administrative unit of the Ministry of the Agroindustrial Complex (MOAIC)." It should be noted that Agrokhimcentre will be the sole distribution agent for the 1998 "Bread of Ukraine" scheme announced in the September 3, 1997, decree. The "Bread of Ukraine" is a thinly veiled, state-owned operation charged with assembly, storage, and distribution of grain. The September 3, 1997, decree will be discussed later.

The distribution system of Ukragrokhim via JSC Agrokhimcentre is the Soviet-era system developed to provide for the storage and distribution of fertilizers to supply Ukrainian agriculture.

The system is extensive with central facilities in all oblast centers and 600 raion centers. Each oblast and raion facility has a steel frame, enclosed building capable of storing bagged or bulk fertilizer. The storage capacity of these facilities was initially reported to be 20,000 mt; however, it is now known that some of these facilities have lower confirmed capacities (2,500-5,000 mt). This discrepancy should not compromise general conclusions.

All oblasts and many raion centers are rail served. Raion centers that are not located on a rail siding are within the service radius of a railhead. Where rail served, bulk hopper cars are received on elevated tracks that enter into the center of the interior of the building. Bulk shipments are emptied by opening the hopper gates and letting the material flow by gravity from the elevated car (0.9-1.5 m above the floor) to the floor on each side of the track. The material is then moved and backpiled with front-end loaders. Bagged materials in 50-kg, 500-kg, and 1,000-kg ("minibulk") woven polypropylene bags are received by boxcar and transferred to stack storage.

Limited site visits to these centers by team members revealed these facilities to be in poor condition and not fully capable of preserving the quality of fertilizer materials. In particular, observations were that roof and siding renovation was needed to assure product integrity. The manner of receiving, stockpiling, and storing when combined with general storage conditions lends credence to reports that the distribution system incurs losses of 15%. This need for remedial action to reduce the losses is underscored by the fact that the 15% shrinkage on the 1,200,000 nutrient tons programmed for the 1998 Bread of Ukraine scheme implies a potential loss of US $30 million (based conservative value of US $200 per nutrient mt). International experience in handling bulk fertilizers suggests losses should not exceed 0.5% for each transfer or a total of 1.5% for typical plant-to-field distribution involving three transfers. Shipments in bags should experience losses significantly below that of bulk.

Logically not all distribution facilities are in poor condition; however, some of these facilities may have limited market value. An official of the State Property Fund of Ukraine (which facilitates and documents privatization) stated that "once the privileged shares or claims on these distribution facilities are transferred and the remaining shares go on the open market I expect few, if any, shares

will be purchased because these shares have no value." This is a telling comment not only on the condition of the facilities but also on the prospect of commercializing the system. However, this does not rule out the effective use of selected facilities in private sector fertilizer distribution enterprises, only that discussions will require considerable business analysis.

2.5.1 Rail Transportation — The railroad system in Ukraine is operated by the state-owned company, UKRZALIZNYTSYA. The system is extensive and serves all areas. The system service map observed indicated all points in Ukraine are within 50-60 km of a rail service point. The rail equipment observed was in good condition and the rails and ties appeared in good condition (**Figure 1**).

Although state-owned, the railroad reliability exceeds that reported for highway transportation. Distributors and traders with established contacts with rail authorities indicate that the system, while sometimes slow, is reasonably reliable and predictable. However, it was frequently mentioned that since the system is state-owned it is always vulnerable to political interference. System users said that obtaining freight rates was often difficult and carried a charge of 7 UHR (US $3.78) for each request. In addition, there is a reported charge of UHR 200 (US $108.11) for placing an order. A commercial (for fee) service provided by "expediters" in obtaining quotes and negotiating rates is used by many shippers.

The available equipment includes covered hopper cars for dry bulk materials, box cars for bagged materials, and tank cars able to handle liquid fertilizers. Some producers own tank cars for moving liquid fertilizers such as aqua ammonia, urea ammonium nitrate solution (UAN), and 10-34-0. The tracks are of a different gauge from those of west European countries, causing delays at the border while the equipment is adjusted to fit.

Agrokhimcentre distribution specialists note that fertilizer prices include US $5-$7/mt of material produced at several points in Ukraine, e.g., for ammonium nitrate, urea, or ammonium phosphates. NPKs, which are only currently produced at one location in western Ukraine, have an

average of US $10/mt of freight built into the price. This tends to support the observation that the state operations enjoy preferential rates (**Table 6)**.

2.5.2 Road Transportation — The highway system consists primarily of 2-lane hard surfaced roads that connect major cities. There is only a limited mileage of 4-lane highways. The roads into the villages and farms are seldom paved and often riddled with potholes making vehicular traffic very slow and subject to damage.

Highway truck transportation for fertilizer is primarily used for local distribution from a railhead service point to local dealer or farm storage. This travel distance most frequently reported is 30 to 50 km.

The majority of the available highway equipment for bulk fertilizer movement is of the straight, dump, 15-mt capacity body type. It is reported these vehicles will often pull a small farm-type 5-mt capacity trailer to enable a total movement of 20 mt. The availability and use of larger 22-mt dump trailers is limited as long hauls do not appear as cost effective as the railroad for shipping materials from the manufacturing sites to the local distribution points.

Fuel prices are reasonable by world standards. The price for 93 octane gasoline is 0.64 UHR/liter (US $1.31/gallon) and for diesel is 0.45 UHR/liter (US $0.92/gallon). This cost, coupled with the low labor costs suggests truck operating costs of less than US $1 per truck mile traveled. With such operating costs, heavy use of trucking to move fertilizer would be expected. This expectation is tempered by the lack of a highway system that permits efficient travel of highway *vis-à-vis* the railway system (**Table 6**). There are also rather widespread reports of police stoppage, interference, and harassment of road transport that have to be factored in.

2.5.3 Waterway System Options — The main seaports of Ukraine on the Black Sea are Illichevsk, Odessa, Reni, Kherson, Yuzhnyy, and Nikolaev which facilitates imports and exports. Access to central Europe is also available via the Danube River.

Water transport to the interior of Ukraine is available via the Dneiper River. There are four locks on the river to allow passage around dams, and the river is considered navigable from the Black Sea to the northern border and beyond into Belarus.

The Dneiper River flows from central Belarus down to the northwest coast of the Black Sea. The river mouth on the Black Sea is located between the three most important Ukrainian ports — Odessa, Nikolaev, and Kherson. The distance in nautical miles from the river mouth to Odessa is 26, Kherson is 51, Nikolaev is 44, and Illychevsk is 42.

The northern portion of the river, from the Belarus border down to Kiev, is navigable for pulled and towed barges of capacity up to 600 mt or for self-propelled barges up to 500 mt.

The ice free navigation season north of the port of Kherson generally lasts from April to November.

The port of Kherson and the river south of the port is normally kept open 12 months of the year by an icebreaker and the traffic of ocean size vessels. The port of Kherson and the waters to the south are considered as seaways and subject to the international rules for seagoing vessels. Kherson Seaport has 9 docks totaling 1,500 m in length and storage area of 167,000 m^2 including warehouse storage of 22,900 m^2 with a capacity to handle 4,100,000 mtpy. In 1996 Kherson port handled 1,780,000 mt.

The river system currently handles cargoes of grains, ore, cattle, metals, fertilizers, and containers (20 and 40 ft) of vegetables and fruits.

The movement of fertilizer on the river system is devoted mainly to the export of Ukrainian produced fertilizers using the southern section of the river from Kherson to the Black Sea. Reportedly 85% of export-bound Ukrainian-produced fertilizers pass through Kherson, arriving there by rail for transfer to vessel. One source reports that each week 3,000 to 5,000 tons of ammonium sulfate is loaded and shipped to Turkish ports. It was also reported the export of bagged NPK mixes in 50-kg bags or 500-kg big bags have been made in the past.

Vessels traveling on the river vary from towed or pushed barges of capacities ranging from 300 to 1200 mt and self-propelled vessel capacities vary from 600 to 1,800 mt. Vessels of overall length of up to 200 m and 7.6 m draft can navigate upriver to Kherson. From Kherson to Dnepropetrovsk, river traffic of river/sea vessel type of up to LOA of 118 m and a maximum draft of 3.75 m are permitted.

From Dnepropetrovsk to Kiev, river traffic permits vessels of river type with LOA of up to 118 m and draft of 2.4 m plus all types of barges of maximum height between the keel and topmost point of 16 m.

The channel depths average as follows:

From mouth of river up to Kherson	7.5 m
From Kherson to Dnipropetrovsk	3.7 m
From Dnipropetrovsk to Kiev	3.0 m

Seasonal changes of water level are between 35 cm and 70 cm of above data.

Points on the river system equipped with cranes of up to 16 tons cargo capacity and cranes for unloading bulk cargo are located in Kherson, Kahovka, Nikopol, Zaporazhe, Dnepropetrovsk, Krememchug, Cherkassy, and Kiev.

The potential to increase use of the river system is supported by many sources. Some experts estimate that the Dniepro River ports and the waterways are utilized at only 15% of potential. All ports are reported to be empty much of the time and there is a desire on the part of port administrators and vessel operators to increase traffic and cargo volume. It was reported that fees such as canal pilotage fees, harbor pilotage fees, locks fees, agency fees, and tonnage and canal fees are open to negotiation if the frequency of the material to be moved is substantial.

While the Dneiper River has potential to offer savings in water transportation, it is not viewed as currently able to realize its potential for fertilizer due to the following reasons:

1. Since few of the fertilizer production points are located on the river, use of the river to move domestically produced fertilizers would require that product be moved from the factory to a

river port, transferred to a river vessel and moved to another river port, transferred again to another river terminal or land transport, and then stored again at a local terminal for distribution to farms. The numerous moves and transfers would not be cost effective in view of the economical and extensive rail service available.

2. The river is closed north of Kherson for approximately 6 months from November to April, depending on the winter temperatures forming ice and blocking vessel travel. This is a key stocking period for spring fertilization.

In summary, the rail system will continue to be the mode of choice for major fertilizer movements. Truck transportation is considered economically feasible for hauls of 50 km or less in most cases; on the better quality highways near fertilizer plants, hauls of up to 100 km. River transportation has limited use for domestic fertilizer movements. While there is some potential, it currently is considered limited given existing plant locations and limits on winter shipping. However, economic adjustment will eventually require a rationalization of plant locations as new investments are made and the potential for river transportation freight advantages should be factored into the evaluation of alternatives.

2.6 The Production Sector

Following is a description of the fertilizer production sector. **Appendix II** includes the capacities of the nitrogen-producing factories and comparative production costs for Ukrainian fertilizers.

2.6.1 Nitrogen — The Ukrainian fertilizer production capacity is dominated by nitrogen. There are six enterprises producing nitrogen: Cherkassy-based "AZOT," Gorlovka-based "STIROL," Dneprodzerzhinsk-based "AZOT," Severodonetsk-based "AZOT," Rivne-based "AZOT," and Odessa Seaport Factory. The total annual nitrogen capacity, on a metric ton of nutrient basis, is variously reported to range from 3.2 to 5.6 million mtpy N. Conventional Ukrainian N capacity reporting does not include ammonia. The MOI reports the country's N capacity as 3.0 million mt of N as urea and 2.3 million mt of N as ammonium nitrate. The MOI data on N capacity was reported as excluding the Odessa Seaport production into the domestic supply-demand balance since it is described as for

export and "not for agriculture." To further cloud the issue, some N is marketed domestically as anhydrous ammonia, aqua ammonia, UAN, and in combination with phosphates as ammoniated phosphates (MAP and DAP), ammoniated SSP, nitric phosphates, and 10-34-0 base solutions.

Estimates of nitrogen production capacity developed for this study reveal a production capacity of ammonia at 4,644,000 mtpy N, a urea capacity of 3,465,000 mtpy product (1,593,900 mtpy N), and an ammonium nitrate capacity of 2,730,000 mtpy product (928,200 mtpy N) (**Appendix II**). Therefore, it is believed that the MOI reports of 3.0 million mtpy of N as urea and 2.3 million mtpy of N as ammonium nitrate results from confusion over reporting on a nutrient and a product basis. The bottom line is that the Ukrainian capacity of urea and AN, currently the most common N fertilizer products, is much lower than frequently reported, but it is fully adequate to satisfy the current depressed levels of consumption.

The nitrogen industry is based on imported natural gas from Russia and Turkmenistan (via Russia). Ukrainian gas production is currently dedicated to satisfying residential and commercial demand. There has been some retrofitting and upgrading of the nitrogen plants, but the facilities are aging and overall gas efficiency is considered low at 1,370 nm^3 per metric ton of ammonia.[1] (The MOI reported current gas consumption at 1,237 nm^3 and a goal of 850 nm^3/mt for the near future.)[2] Preliminary cost estimates for bulk urea suggest Ukrainian product would be approximately US $115/mt with gas priced at US $83/$Mnm^3$ (the 1997 natural gas price), and costs could be lowered to approximately US $102/mt if the target price[3] of US $66/$Mnm^3$ could be achieved in 1997/98. Ammonium nitrate costs factor to approximately US $100/mt and US $90/mt for US $83/$Mnm^3$ and US $66/$Mnm^3$ for natural gas, respectively. Recent estimates suggest Middle East urea costs of approximately US $56/mt. Therefore, when a US $15-18/mt shipping cost disadvantage for Ukrainian urea as compared with Middle East product in the Asian market and the depressed

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[1]Units used: nm^3 = normal cubic meters; Mnm^3 = 1,000 normal cubic meters.

[2]The amount of 850 nm^3/mt would be equivalent to a 40% gain over current efficiency and is considered an unattainable goal across all facilities.

[3]The $66/$Mnm^3$ natural gas price may be more appropriately described as a "hoped for price" rather than target price, *per se*. Rent seeking in gas pricing has been reported and it is highly improbable that sufficient competition has been injected to achieve this price level, other things equal.

Ukrainian farm demand for N are factored in, it is easy to explain why the Ukrainian nitrogen fertilizer industry is currently operating at 50% or less of annual capacity.

Given economics of size associated with fertilizer production, these preliminary estimates may overstate competitiveness. Indications are that exports have been pursued in part to clear stocks and generate foreign exchange to retire accumulated external debt and generate funds for needed maintenance and repairs. A short-run decision to operate if variable costs are recovered and some contribution can be made to fixed costs and overhead would be rational. Since the plants are not completely privatized, there is also the possibility of indirect subsidies. The estimates do suggest that if the industry can lower natural gas costs Ukrainian finished products would be internationally competitive and would lower prices to the Ukrainian farmers.

2.6.2 Phosphate — In 1990 Ukraine's phosphate production was reported at 1.65 million mt of P_2O_5 and the largest in Europe; by 1995 P_2O_5 production was only 0.30 million mt P_2O_5 or 15% of the 1990 level. It was not possible to fully confirm 1997 P_2O_5 productive capacity in terms of phosphate products, but the MOI did report 1.1 million mt P_2O_5 capacity. Based on available information, P_2O_5 capacity appears to be concentrated at three complexes in Eastern Ukraine at "Sumy Khimprom" and in two complexes in western Ukraine at Rivne ("JSC Rivneazot" and "Rozdil Plant Suka"). It was suggested that these facilities have the capability to produce 642,000 mtpy of granulated superphosphate (20% P_2O_5), 1,015,000 mtpy ammonium phosphate (52% P_2O_5), 628,000 mtpy of nitric phosphates (17-17-17), and 858,000 mtpy of liquid phosphatic fertilizers (10-34-0). Feed-grade phosphate production capacity is significant with 140,000 mtpy of P_2O_5 reported.

There is no phosphate rock production in the Ukraine at present and the subsector is faced with a shortage of raw materials. Apatite concentrate and/or phosphate rock has been imported from Russia, but imports have declined dramatically since independence. One observation from the Rivne location reported recent Russian imports from the Kola Peninsula at a cost of US $78 laid-in to Rivne for 38%-39% P_2O_5 rock. The MOI indicated that phosphate producers would have to turn to North African sources of phosphate rock (PR), and a recent "test" shipment of 20,000 mt of PR from

Algeria was reported. However, there are some concerns over the radon and heavy metal content of this rock. Reports reveal products from the Algerian PR are being "investigated."

A shortage of PR is not the only problem faced by the Ukrainian phosphate sub-sector at this time. There is only limited indigenous sulfur available. The Ukrainian sulfur industry was based on open-pit mining and the resource is no longer economical when appropriate environmental costs are considered. The limited domestic sulfur available is priced at US $80/mt; however, recovered sulfur from Russia may be available at US $62/mt.

These phosphate facilities are aging and reported to be causing "ecological problems." It is believed the ecological problems are associated with fluorine emissions, accumulations of flotation fines and gypsum, and the reclaiming of sulfur mining overburden. Previous management did not set aside an environment fund to deal with these problems. The fluorine emission may be a particular problem since glass windows at the Sumy complex were observed to be heavily etched and one source reported fluorine emissions have increased by approximately 50% over the period 1991-95.

There is interest in trying to develop indigenous P_2O_5 sources, but indications are this is a very long shot at best. The raw material of interest is described as a 7% P_2O_5 bearing sand that is 70 m deep. Mining and concentration costs should render this option not feasible.

One Ukrainian scientist, Nina Tarasova of the National Academy of Sciences, is reported to have concluded that phosphate production in the Ukraine is no longer viable and is quoted as saying, "It would be better for Ukraine to import such fertilizers and phosphoric acid. Unprofitable, outdated enterprises should be gradually closed down, since they pose a threat to the environment."

Given current conditions the Ukrainian phosphate sector would appear to be at a considerable cost disadvantage as compared with the United States in phosphoric acid production (US $330.31/mt versus US $192.84/mt), in DAP production (US $207.24/mt versus US $132.92/mt), and in MAP production (US $219.07/mt versus US $135.81/mt) (**Appendix II**). Cost differences of these magnitudes strongly support Ms. Tarasova's conclusion.

2.6.3 Potash — Ukrainian potash production is located in Western Ukraine. It is understood that sulfate of potash magnesia (Sul-Po-Mag) is produced from langbeinite occurring in salt deposits, but domestic production has recently declined significantly. It was reported that during the Soviet era, with discovery and development of potash resources in Belarus and Russia, the potash production facilities in Ukraine were allowed to deteriorate. Currently, Ukraine is heavily dependent on inputs from Belarus for potassium.

There are indications that the langbeinite and kainite deposits have attracted potential foreign investor interest. Funds are needed not only for mine development or restoration but also for replacement of processing capacity. It was learned that IMC-Global had scheduled a visit to the area in October 1997 to investigate investment opportunities. Sul-Po-Mag, a chloride-free potassium source, is a valued specialty crop fertilizer with export potential.

2.6.4 NPKs — There is one large state-owned NPK production facility, Rozdil Plant Suka, located near Lviv in Western Ukraine. The plant has a rated annual capacity of 600,000 mt of product, one of the largest in Eastern Europe. The plant has the capability to produce several NPK grades but primarily produces grades 17-17-17 and 15-15-15. The MOI reported the plant is approximately 40 years old and is currently closed "because of sulfur and ecological problems." The ecological problem could be the gypsum stack accumulated over the last 40 years.

It was reported that Rozdil could earn a 10% margin on the established price of US $160/mt. If the plant is operational, a cost estimate made for this study suggests this information is valid and could provide Ukrainian agriculture with competitively priced NPKs (**Appendix II)**. However, the age and condition of the facility will be the primary determinant.

2.6.5 Summary — In summary, fertilizer production facilities in Ukraine can be characterized as aging and in a poor state of repair; however, condition varies considerably from subsector to subsector. The nitrogen production facilities are in the best condition relative to the phosphate and potassium subsectors. All three subsectors are faced with basic raw material constraints that serve to compound technical production problems.

The Ukraine fertilizer industry is dependent on imports. In nitrogen, Ukraine imports natural gas from Russia and Turkmenistan (via Russia) primarily through the parastatal Russian supplier, Gazprom. Accordingly, Ukraine is not able to harness competitive forces in the natural gas market which results in a relatively high price (US $83/Mnm^3) finished nitrogen product prices that are not competitive with other current generation world plants. This lack of competitiveness is not only due to natural gas pricing but also as a result of insufficient investment and operating capital for upgrading, retrofitting, and maintenance.

The phosphate and potassium subsectors are highly vulnerable. The country is not basic in phosphate raw materials and evolved reflecting the dependence on Russian sources. Economic realities are forcing a turn to other international sources but in doing so faces infrastructure constraints and reduces economic feasibility thresholds. In addition, facilities are old, have not been well maintained, and have major environmental problems. While Ukraine has potassium mineral resources, the facilities, mining and processing, have deteriorated and the country is now dependent on imports of finished product from Belarus. The country does have potassium resources that can be used to produce a quality specialty fertilizer with high export potential. This potential for export may be the impetus needed to attract the necessary foreign investment. In total, these subsectors are facing a period of major economic adjustment that will require rationalization of existing facilities and infrastructure against supply and demand realities.

2.7 The Marketing Sector

2.7.1 The System and Situation — In the Soviet-era, fertilizer production, distribution, and use decisions were made by a central planning authority. Given centrally determined food and fiber production goals, state and collective farms submitted fertilizer (and other input) requirements to raion administrators for subsequent forwarding to the oblast and state administrative authorities. At each subsequent higher level authority on the planning apparatus, the fertilizer requirements were reported to be "adjusted." However, the adjustment process was not transparent. (The process started at least 1 year in advance.)

Eventually, these adjusted needs or allotments were translated into production quotas to the fertilizer plants for fertilizer products to be delivered to the state mineral fertilizer distribution agency. Directives to the central distribution agency then ordered delivery of the fertilizer allotments down through the oblast and raion apparatus to the state and collective farms. Any mineral fertilizer used by household plots was obtained from the state or collective farm. Fertilizer, as well as all other inputs, were "paid" for in-kind by delivery of crop and livestock products according to delivery quotas.

This distribution system was *command-driven* without clear criteria or mechanisms that facilitated resource use and allocation decisions at the farm level. The system did work as evidenced by the production levels attained in the 1980s (**Table 3**). However, without clear criteria (relative prices or values) to guide resource use decisions, the system did not achieve the levels of technical and economic efficiency commensurate with Ukraine's resource endowment and was not sustainable. Such poor performance and the ultimate negative impacts on consumers provided some of the pressure that led to national independence and movement towards a market-driven economy.

The transition to a market-driven system has only just begun. The system has been in total disarray. For example, fertilizer use has fallen each year since independence; in 1996 use was only 10% of 1991 on a total use basis or 16% on a per hectare basis (**Table 7**). However, the government has remained the dominant market player supplying 97% or more of the fertilizer used in 1996. Reports from some quarters suggest the private market share has expanded marginally in 1997, but Agrokhimcentre, the recently "privatized" parastatal charged with mineral fertilizer distribution, reports the "state distributed 97% of the fertilizer in 1997." The primary change made in the system has been to allow farmers and farm mangers to purchase fertilizer from alternative suppliers *if* they have cash or the alternative suppliers will accept in-kind payment. However, in practice the command system is still very much in evidence.

Only when cash purchases are made from the state apparatus are prices firmly fixed. Experience is that exchange ratios (grain for fertilizer) established when fertilizer delivery is taken tend to deteriorate by the time that in-kind payment is made. In fact, there is widespread belief among

participants that the state establishes ratios attractive to the farmer (and fertilizer use) in the planting period to deliberately attract "customers" and prevent growth of the private market share. The strategy is based on the tradition that ratios will be state-favoring terms of trade by the time accounts are settled. This practice is reinforced by the state's monopoly position in storage and processing and by policy which dictates that all debts (for fertilizer and other production inputs and services) to the state must be satisfied before the revenues are made available to the grower for other purposes. Given the low productivity, farms and farmers have little or no marketable surplus and have essentially become sharecroppers similar to those of the "old South" of the United States. Each year finds them deeper in debt and tied even closer to what remains of the command system. The system is not economically sustainable and can only persist as long as the state essentially controls the farms and the input and output marketing processes.

Farmers are attempting to bypass this system as some measure of freedom has been achieved. The household plot growers do not seem to be particularly affected. These units have traditionally relied heavily on the use of organic fertilizer and capitalize on relationships with larger farms for access to other commercial inputs and field work. The new true private farmers — those 35,500 families, each on average with 24 to 25 ha (nationwide totaling 835,000 ha) — are increasingly bartering future outputs for access to production inputs from the private dealers (**Table 8**). Their stated goal is to exclude the state from their input or output marketing relationships. The remaining large collective farms and those that have been "privatized" as joint stock companies (but which largely still operate as state farms) have little choice but to participate in the state schemes or programs because of limited options to fund input purchase. However, field visits revealed these farms are increasingly exploring non-state input supply options.

Private agricultural input distribution is in its infancy in the Ukraine. Initial market penetration has evolved around crop production chemicals and the provision of custom services (especially harvesting), areas where the state apparatus has been most vulnerable from a competitive standpoint. These input suppliers have encountered considerable state interference and barriers to competition. These barriers have been widespread — particularly in the fertilizer sector — ranging from "bureaucratic stonewalling," predatory licensing fees and taxes, and imposition of arbitrary laws to

limitations on sales of grain taken as in-kind payment or taxes on repatriation of profits. Many have incurred substantial losses. Therefore, these firms have been very cautious about expanding into fertilizer distribution where the state has held a commanding comparative advantage. Where private fertilizer distribution is emerging, it is being introduced to "round out" the product line and attempt to reduce the farmer's linkage to the state apparatus. Those enjoying some measure of success appear to be those that have developed ties to countervailing political powers at either the raion, oblast, or state level. As long as the state is a dominant market participant, countervailing political power (or "pull") will be an important strategic element in the fertilizer market. There simply is too little competition to rely on business acumen alone to be successful.

2.7.2 Marketing Methods—The parastatal distribution agency, Agrokhimcentre, is a passive marketer at best. It still is heavily weighted towards relationships developed under the command system and has not developed business relationships with farmers. A customer focus was not evident; these distributors do not try to "sell" fertilizer based on economics of use concepts or by offering value-added services. This lack of a business acumen often manifests itself in statements (and beliefs) such as "all fertilizer marketing problems are due to the farmer's lack of cash," "we are waiting for farmers to place orders," or "our main problem is due to farmers having the freedom to make decisions." Since only a very small sample of Agrokhimcentre units were visited, it is quite possible that some of these units have much more of a commercial orientation than the norm. In fact, some units are reported to have maintained the relationships with agronomists and managers of the farms under central planning and occasionally hold seminars for technology transfer purposes. But the bottom line is that 93% to 97% of the fertilizer used in the Ukraine is "distributed" and not marketed, and no transparent incentive mechanism(s) was (were) evident that would drive the system to become efficient and effective. This lack of a coordinating set of incentives is probably the reason the various parastatals expressly want to retain the command system (and the associated coercion).

The marketing methods used by the emerging private distributors are consistent with those practiced by consumer-oriented businesses. Products are introduced and promoted at field days and on-farm demonstration plots. Promotional literature is widely disseminated and use of advertising is common. Meetings are held with managers of large farms to discuss agronomic issues and transfer

technology. The strategy appears to be to develop an appreciation (or excitement) for the industry and to nurture supplier-customer relationships basic to development of customer loyalty. In total, the approaches being taken suggest a long-term commitment.

The private distributors visited that are actively engaged in fertilizer marketing are being forced to be highly innovative to overcome the chronic lack of cash in agriculture, the inability to collateralize land and a lack of commercial credit, and the real and potential interference from the state. Dealers must find sources of appropriate fertilizers, often requiring payment in advance or arranging for inputs for the plants to produce the products. Fertilizers are then advanced to farmers secured by an in-kind contract on the crop to be produced. This phase has high risks because the generally poor quality of production techniques such as: poor and excessive land cultivation; use of poor quality seed, crop protection chemicals, and/or inappropriate nutrient management; lack of timeliness in sowing and fertilizer application; poor application efficiency; and poor and untimely harvesting and post-harvest handling. These conditions often result in the need to renegotiate contract terms and accept substitutions of lower quality, and frequently less marketable, in-kind payments. Once the commodities have been received — a substantial feat in itself given farm economic conditions, the virtual lack of a legal process to enforce civil contracts, and state interference — the fertilizer dealer must then turn commodities into cash. This process frequently involves several barter "turns," each with high transaction costs (albeit with concomitant profit potential) before a final export sale can be made to repay foreign suppliers and investors (and avoid the VAT).

The extent to which private farm supply distributors are persistent in Ukraine, often in face of significant financial loss, underscores the potential of Ukraine's agriculture and their readiness to posture their firms to capitalize on the market opportunities, if and when the market is opened to competitive forces.

2.7.3 Market Facilitating Infrastructure — Full development of an openly competitive market for fertilizer has some prerequisites. While not an all-inclusive list of prerequisites, the following are considered key: commercial law, evolution of commercial credit, fertilizer regulations, information access, and output market reforms. These are briefly discussed below.

2.7.3.1 Commercial Law — At present commercial transactions in the Ukrainian fertilizer market are without legal protection. The basics of a coherent legal system to support a market economy outlined by Bromley (p. 7) includes: "(1) clear lines of authority and division of responsibility among government units; (2) clarity and precision in legal rules; (3) mechanisms and processes for the protection of property rights; (4) procedures that offer stability and predictability; (5) a sense of farmers focused on law as a process more than an outcome; and (6) accessibility of laws and regulations to the public." However, as McDowell appropriately points out, there is a need to go beyond the strict legality concerns of having laws and enforcing them, but the citizens must be willing to follow them and voluntarily behave. Ukraine has not reached the point that impersonal exchange activities are the rule rather than the exception; it appears it is a long way to a competitive market.

2.7.3.2 Evolution of Commercial Credit — Commercial credit to finance agricultural input purchases is nonexistent in Ukraine today, forcing the market to resort to in-kind payment arrangements which are of high risk and tend to result in high transaction costs, ultimately distorting prices. The availability of commercial agricultural credit would be improved by institution of a land market (for collateralization) or agricultural-oriented banks. The Ukrainian banking system is in its infancy and discussion with banks and observers suggest that banks will not be financing input purchases over any foreseeable planning horizon because of collateral problems and more attractive opportunities in the commercial sector. However, the lack of commercial credit services by the banking system would be overcome to some degree by a land market. And the collateralization of land would be expected to hasten emergence of a banking system that will serve agriculture.

In the interim, suppliers are providing limited financing of production inputs. This activity is beneficial in the short term but due to the cost to the user and risk to providers, supplier credit is not considered a long-term solution to financing Ukrainian agriculture. Eventually banking institutions will have to fulfill this need.

2.7.3.3 Fertilizer Regulation — Consumer protection or fertilizer control regulations are necessary for creating and sustaining a market-friendly environment. The legal framework and institutions for regulation, monitoring, and enforcement of commercial fertilizer transactions must be

provided. At each stage of the fertilizer marketing channel, the buyer must be reasonably confident that he or she is actually obtaining a product agreed to and purchased and that a system exists to allow for prompt resolution of conflicts. If this basic institutional mechanism is not provided, there is a high probability the market will not provide the efficient and equitable solutions desired. First, a basic set of regulations must define the rules of exchange. Second, provisions must be made for sampling and testing to determine if products meet quality and quantity specifications. Third, if discrepancies or deficiencies are detected, a legal framework must be available for prompt resolution of conflicts and penalties to compensate for deficiencies. However, when the government is the dominant market player, as in the case of Ukraine today, there is a concern of non-market failure or the government's manipulation of the regulatory mechanism to offset or nullify competitive conditions.

2.7.3.4 Information Access — Sound business decisions in a market environment are information intensive. Development of science-based, market-oriented fertilizer and crop response data and the widespread dissemination of that information in education packages, which can easily be used by farmers, are critical to capturing the benefits of market reforms and facilitating economic adjustment. Likewise, timely assessments of the domestic and international fertilizer supply and demand situation, including prices of inputs, outputs, and transportation rates and availability, are critical to efficient market solutions. Similarly, identification, documentation, and dissemination of information on unscrupulous business practices can be strong deterrents to both market and non-market (government) failure and to ensure that the market works efficiently and effectively. In general, the higher the quality of information provided, the higher the quality of decisions made by all participants, and the fairer and more equitable will be the solutions provided by the market.

2.7.3.5 Output Market Reforms — Output marketing infrastructure and processes are just beginning to evolve in Ukraine. The state still dominates food and fiber marketing through state firms, thinly veiled as private firms, at the assembly, handling and storage, and processing stages. Prices are tacitly fixed and/or at least manipulated by the state apparatus. The result is distorted prices which result in highly inefficient production and consumption decisions. In addition, development experience

worldwide suggests achieving output market reforms will serve as the impetus to solve many of the barriers itemized above, especially the provision of commercial credit.

Particularly unsettling is the apparent lack of understanding of or appreciation for the role the export market will have to play in addressing the excess capacity in grain production characterizing Ukrainian agriculture (**Table 9**). Possibly owing to its isolationist past as part of the FSU command-driven marketing system, the GOU has not demonstrated understanding that the situation requires a proactive export policy that encourages high quality and low market friction. Resolution will necessitate a rationalization of Ukraine's entry into the global grain market and what will be required for it to be a successful, consistent supplier. Economies of scale dictate that efficient market systems require volume and consistency of supply.

These open-market prerequisites are not currently available in Ukraine and serve as a barrier to emergence of a competitive fertilizer market.

2.7.4 Customer Base — The Farms — Full transition to an openly competitive market for fertilizer will be highly dependent on emergence of independent, economically motivated farm owners and operators. Agricultural enterprise privatization and farm restructuring will be the key.

The process of privatization began in earnest in 1992 when 14,681 private farms comprising 292,000 ha were established when Ukraine's Land Code of 1992 gave individuals the right to obtain land for family and private farms, private plots, gardening, and dacha (summer home) development (**Table 8**). By 1995 the number of private farms had increased to 34,687 farms consisting of 788,500 ha. In 1995 Ukraine's parliament imposed a 6-year moratorium on the sale of land inherited from the state and effectively brought private farm formation to a halt. By January 1, 1997, private farm numbers had increased only marginally in number and area occupied — to 35,400 and 835,000 ha, respectively. Professionals with the privatization contend new private farms are currently being formed each day in Ukraine; however, informal information gleaned on field visits suggests these additions are being offset by private farms being dissolved due to economic failure.

The Government of Ukraine (GOU) contends that virtually all of the collective farms and more than 75% of the state farms, about 85% to 90% of Ukraine's agricultural land, have been privatized. The consensus opinion is that this privatization is in name only or "paper" privatization. One source reports "Most large-scale farms continue to operate without restructuring, are unprofitable, and are falling deeper into debt. Management, for the most part, has remained unchanged. The paper reorganization has provided little economic or other stimuli for collectives to restructure into profitable production units" **[USDA, 1997, p. 33]**. Attempts to validate the economic conditions of the large farms yielded estimates that 50% of the JSC farms are bankrupt, 40% are salvageable with restructuring of debt and creative accounting, and 10% are solvent.

In total, the current situation raises considerable questions about the timeframe required for development of an economically serviceable market built on economically viable units. The private plots and farms, which account for approximately 13% of total agricultural land and 10% of the arable land yet provide for 47% of the total agricultural output, could be the foundation for an expanded and successful private sector. These farms tend to be more productive than the larger farms and obviously respond to economic signals. In crops and commodities where small farm and plot producers have market access, these units are major producers. For example, it is reported that farmers and household plots accounted for 82%, 96%, 57%, and 52% of the total vegetable, potato, meat, and milk production, respectively, in 1996 **[USDA, 1997]**. While these private units are relatively numerous and profit motivated, they are small, too spatially dispersed, and rely heavily on organic fertilizers (especially the household plots). In addition, they frequently have strong linkages to the larger state-oriented farms. At present these units alone do not provide a viable market base for fertilizer. Full development of a competitive market for fertilizer will be largely dependent on the speed at which the large farms are restructured and transformed into economically motivated farm owners and operators.

A number of the JSC farms have a privatized structure that in reality differs little from the old system. Former farm employees now own shares of the former large collectives. In many instances the former managers of these farms have negotiated leases of these shares in attempts to keep the farms operating. These share owners are now employees of these "private" managers, as opposed to

being members of collectives. While these managers are not necessarily the best farmers, many are proving to be politically adept and may well be the bridge between the farm organizations under the command system and the economically viable options that will ultimately arise under the market system. For example, some of these managers have opened direct trading with commercial markets in Poland and others are severing their ties to the state-order system and are dealing directly with private suppliers for agricultural inputs and commodity marketing.

The type, size, structure, and organization of farms that evolve in Ukraine will have important implications for the type of fertilizer marketing system that will have to develop to efficiently and effectively supply fertilizer under competitive conditions. There are simply too many variables and unknowns to hazard a guess as to what Ukrainian farms of the future will resemble. However, Ukraine's resource endowment provides it an apparent comparative advantage in grain production, and suitability of grain production to large-scale farming suggest that the current emphasis on large-scale farms will be difficult to dislodge.

2.7.5 Farm-Level Constraints in Fertilizer Use Efficiency — Observations made during field visits suggest there are several factors negatively impacting current fertilizer use efficiency and, therefore, economics of use. While there are many necessary conditions for the development of an openly competitive fertilizer market, the sufficient conditions for such development center on improving economics of fertilizer use.

Indications are that fertilizer application efficiency is poor. On field visits it was the norm to be able to identify poor spread patterns from the "windshield" by the undulation of crop height and color. The most common fertilizer spreader observed on large farms was a pull-type, bulk wagon with a ground-driven, rear-mounted, centrifugal spinner spreader; on private farms the most common spreader observed was a three-point hitch-mounted spreader with a power take-off driven centrifugal spinner. The machinery observed was worn and in very poor general condition due in part to original poor quality but severely compounded by poor maintenance and unprotected storage. There were no indicators that the equipment had been recently calibrated. Data provided by Ukrainian Institute of Agrarian Economy indicated the availability of mineral fertilizer spreaders decreased by roughly 25%

between 1990 and 1996 (**Table 10**) and suggested an annual need of 10,200 units (**Table 11**). There is also an apparent shortage of equipment for sidedressing the major row crops, especially corn, with either dry or liquid materials. Sidedressing does not appear to be a common practice in Ukraine at present, but it is advocated by agronomists as a way to increase efficiency. One professional opined that due to poor and improper fertilizer application no more than a 50%-60% use efficiency was currently being attained [**E. Dehodiuk, personal communication, 1997**].

Organic fertilizer handling and spreading equipment is in particularly short supply as evidenced by the labor intensive handling and field stacking procedures observed. Material is often stacked in large piles in the fields and "pushed around" by a front-end loader or by hand, resulting in overfertilization in the small areas around the piles and none over the remaining areas. Given the poor application procedures of these operations and the dramatic drop in livestock numbers since independence, it is little wonder organic fertilizer use in 1996 was only one-third of 1990 levels. Availability of manure spreaders decreased 25.6% over the same period (**Table 10**). Manure spreaders are not produced in Ukraine and traditional suppliers are the FSU countries. Shipments are reported to be sporadic and unreliable if funds are available.

The shortage of basic equipment to perform field operations in a timely manner also has a significant impact on fertilizer use efficiency and productivity. The agricultural machinery complement of Ukrainian agriculture has been devastated by conditions existing prior to and since independence. The Director of Agrotechservice, the state agricultural machinery agency, in response to a question on the seriousness of the agricultural machinery situation, replied "It is not serious; it is catastrophic." Agrotechservice estimates 515,000 tractors are needed to properly service Ukraine's agriculture but only 160,000 are available, of which 59,000 are fully depreciated. (These data are consistent with the Institute of Agrarian Economy estimates and are believed to reflect national agricultural plan base data.) However, Agrotechservice estimates suggest a tractor "need" of one to each 66 ha of arable land. Americans currently operating farming operations in the Ukraine are obtaining a tractor-to-land ratio of 1:2,500 ha. It is apparent projected need is highly inflated.

The narrow product line of fertilizers available to meet crop nutritional requirements in Ukraine is also negatively impacting fertilizer use efficiency. Succinctly, farmers are fertilizing their crops with the materials to which they have access, rather than those needed for proper nutrient management. Fertilizer use is heavily weighted towards nitrogen. In 1991, 126 kg of mineral fertilizer nutrients was applied per cultivated hectare, roughly composed of 42% N, 29% P_2O_5, and 29% K_2O. In 1996, use had decreased to 21 kg/ha consisting of 73%, 19%, and 8% of N, P_2O_5, and K_2O, respectively (**Table 7**). Use efficiency is expected to decrease when the ratio of N:P_2O_5:K_2O use changes this dramatically.

The relatively higher use of nitrogen may be temporarily masking the impacts of this use distortion on productivity, especially on small grains. However, with only a limited number of fertilizers and few options for practicing good nutrient management, impacts on productivity of vegetables and specialty crops may have already been experienced. The 1997 tomato crop was particularly hard hit by disease. Weather conditions and lack of proper CPCs may have been key, but it is highly possible that nutritional stress made the crop much more susceptible to infestation.

In summary, critical farm machinery constraints and the lack of fertilizer product mix diversity is negatively impacting economics of fertilizer use in the Ukraine and, therefore, the potential for development of a competitive market.

2.8 Use Dimensions

Review of Ukraine's historical fertilizer consumption patterns as the basis for estimating future demand is not very practical at this point in time. First, until 1991, the product mix, levels of fertilizer use, and the crops produced were decisions of a command system, while prices of fertilizer, crops, and other inputs were either non-existent or at least unknown at the use level. Second, since 1992 the economic system has gone through such upheaval, it is basically in a state of shock. Third, the government is still dominant in fertilizer production, distribution, and use and in key crop output purchase, handling, storage, and processing resulting in distorted signals. And fourth, price observations are unreliable where available because very little fertilizer has actually been marketed

on a cash price basis. Thus, there is no basis for attempting to use traditional methods or approaches to demand analysis; however, an examination of developments in use does provide interesting insight.

2.8.1 Use Trends— Data on fertilizer use in the Ukraine were obtained from several sources. The various data series tended to be fairly consistent for the pre-independence period but have exhibited far less agreement for the post-independence period. The information adopted as baseline for this study is presented in **Table 7**, which is based on information from the Ministry of Statistics and Ukragrokhim (the state agency in the Ministry of Agriculture charged with agrochemical provision and monitoring). These sources appeared to be the most logically consistent.

Mineral fertilizer use in Ukraine peaked at an average 4.9 million mt of nutrients per year in the 1986-90 period. (Selected data suggested that the peak usage, 5.2 million mt of nutrients, was attained in 1988.) Over the 1986-90 period, actual nutrient use per hectare averaged 148 kg (N, P_2O_5, and K_2O), which reflected a nutrient ratio (N:P_2O_5:K_2O) of 1.0:0.66:0.66. By 1991, the last full year of the command system, fertilizer use had declined (from the 1986-90 average) roughly 22% in total nutrient use and 15% on a kilogram/hectare basis while maintaining the same basic ratio. Since independence (1991), total fertilizer nutrient use has fallen precipitously (92%) as of 1996. On a kilogram/hectare basis, use had fallen to 21.0 kg/ha (85%). (There are indications that this may understate use per hectare rate because up to 25% of cultivable land was believed to be idled in 1996.) On N:P_2O_5:K_2O nutrient terms, the ratio of use recorded in 1996 stood at 1.0:0.26:0.11. Data for 1997 are not available.

Use of organic fertilizer has closely followed the mineral fertilizer use trends. Professional workers indicated the decrease in organic fertilizer of this magnitude cannot be explained by the decline in livestock numbers alone. It would appear that the rational decision in a cash short capital situation would have been to try to increase or at least maintain manure applications. However, the decline experienced suggests machinery and fuel shortages may be much more important than visualized. The relative cost:benefit ratio of manure collection, handling, and application to crop yield appears to be much lower than previously assumed, i.e., under the command system manure costs and benefits were seriously distorted.

The "optimum requirement" in **Table 7** is reported to be an estimate revised downward from the "target" under the FSU system. This optimum is believed to be based on purely physical relationships and extensive soil testing and devoid of relative economics (fertilizer and/or crop). As an artifact of the centrally planned era, it does provide somewhat of a baseline to examine $N:P_2O_5:K_2O$ ratio. The "optimum" $N:P_2O_5:K_2O$ ratio professed to be 1.0:0.93:0.83. When compared with the current ratio (1.0:0.26:0.11), it indicates that fertilizer use is heavily biased towards nitrogen and this situation is compounded by the decline in organic fertilizer. As a general indicator, this supports the professional agronomists concern that soil fertility is being mined and nutrient deficiency symptoms in crops are becoming much more common. This situation has led to the legitimate concern that micronutrient deficiencies will increasingly have negative impacts on productivity.

The downward revision of the "optimum" from the fertilizer use levels or goals attained in the 1986-90 period strongly supports reports that fertilizers were grossly over-applied during the Soviet era. Given the adjustments that will ultimately have to be made due to structural changes being experienced in demand, the true optimum level of use will probably be much lower. Some professionals are of the opinion that 3.5 to 4.0 million mt of nutrients will bracket the optimum when the appropriate market calculus is performed.

2.8.2 Impact of Use Decline — An effort was made to demonstrate the magnitude of the decrease in nutrient use. The objective is to provide policymakers and donors with at least a crude measure of the potential benefits of removing barriers to development of a competitive fertilizer market. In the first instance, Ukraine Institute of Agrarian Economy data as adjusted is utilized to estimate the value of fertilizer consumption foregone in 1996 (**Table 12**). Valuing fertilizer at reported Ukrainian wholesale prices (**Table 13**), the total value of the use deficit was estimated to be US $1.6 billion of which US $925.2 million could be associated with nitrogen, US $647.1 million with phosphorus, and US $36.9 million with potash. The values of the use deficits were of the magnitude and direction expected based on experience and the internal wholesale prices used. Although these are crude estimates, they do point to the significant economic benefits that would accrue to the Ukraine if the constraints to use could be removed.

To place the above estimates in perspective, the 1996 yield loss to selected crops was estimated in physical terms (**Table 14**). The results of this exercise, at the experimental optimum midpoint, reveal that the yield loss in centners per hectare due to the decline in fertilizer use was 20.7, 17.3, 18.2, 256.0, and 117.6 for wheat, barley, grain corn, sugar beet, and potato, respectively. No effort was made to quantify these physical indicators in economic terms because of the lack of output grade and price data. By any measure, the losses attributed to decreases in fertilizer use in 1996, at a minimum, point to high potential benefits of making the appropriate input and output market adjustments.

2.9 Summary

Ukraine has the potential to be a major benefactor from the growing international demand for food if the current barriers and constraints to gains in productivity can be removed. Fertilizer has a major role to play in recovery from the 40%-45% decline in productivity but the preconditions of social, economic, and political stability have to be attained.

The fundamentals for an economically viable fertilizer sector in a competitive open market are currently present in Ukraine. This mission is of the opinion the research base in both fertilizer production and use is sound. The basic distribution infrastructure is in place. While installed manufacturing capacity provides a technical base, economic adjustments will have to be made to compensate for changes in raw material sources and costs, international competition, and the structural shift in demand. In addition, the farming community has experience with and appreciation for fertilizer. However, the government is still a major player (and often an unfair one) in fertilizer production and distribution and in the output markets. The result is that economic signals are distorted, resources are inefficiently allocated, and no mechanism is able to evolve to harness the forces of competition. Until an openly competitive market economy is established, returns must be so heavily discounted for both economic and political risks that few investment alternatives will be economically feasible.

All other conditions satisfied, the major deterrent to emergence of a private, competitive market for fertilizer is the critical lack of commercial credit. Establishment of a land market, true privatization

in the agroindustrial complex, and reform in output markets would effectively relax this constraint as well as provide the impetus for the flow of capital into agriculture.

The potential benefit from the recovery in production in terms of fertilizer alone is estimated to approach US $1.6 billion. The impact of a US $1.6 billion injection into economic activity would be expected to generate several multiples in income and employment due to direct, indirect, and induced effects. Potential benefits of this magnitude should be sufficient to encourage policymakers to ensure openly competitive markets for agricultural inputs and outputs.

3.0 Issues, Observation, and Response to Terms of Reference Specifics

The original Terms of Reference (**Appendix III**) for this study were very broad, encompassing elements of sector analysis combined with elements of issue analysis. Then when the emphasis was shifted to fact finding, difficulties in report format and organization were compounded. Since the current situation in Ukraine is very fluid and dynamic — i.e., changing daily, it was decided to present the situation assessment in narrative (Chapter 2) and address the more topical analysis called for in the TOR separately. This chapter addresses these topical issues as well as those identified by the team.

3.1 The September 3, 1997, "Bread of Ukraine" Decree

On September 3, 1997, the Cabinet of Ministers of Ukraine passed Decree No. 977 entitled "On Conditions for Meeting Agricultural Demands for Mineral Fertilizers for 1998 Harvest." A translation of the decree is contained in **Appendix IV**.

The decree basically establishes outlines of the state marketing plan for mineral fertilizer for the 1997/98 crop year. Essential features are to provide farmers 1.2 million mt of fertilizer nutrients consisting of 856,000 mt of nitrogen, 260,000 mt of phosphorus, and 84,000 mt of potash fertilizer produced in Ukrainian facilities. The key player is the JSC Khlib Ukrainy (Bread of Ukraine) which will issue bills of exchange or vouchers for up to UHR 780 million (US $422 million) to the fertilizer

suppliers to be selected by tender. The amount of the bills cannot exceed the value of the grain Bread of Ukraine expects to receive from the farmers at the 1998 crop harvest as payment for the fertilizer. The bills are to be guaranteed by the Main Department of State Treasury with negotiability serviced by the bank "Ukraine." The bills are guaranteed by grain. The bills are guaranteed in another sense that suppliers of mineral fertilizers will be granted a deferment on taxes owed up to the value of the fertilizer supplied but not recovered. The fertilizers are to remain in the title of "Bread of Ukraine" but will be distributed exclusively by the JSC "Agrokhimcentre," the recently privatized state-owned agrochemical distribution arm. "Agrokhimcentre" will be compensated for distributing the fertilizer to the raion level on a percentage basis.

The most critical provision of the decree is the establishment of a "contest" or tender process to be executed by a government commission consisting of representatives of the Ministries of Economy, Agroindustrial Complex, Finance, and Industrial Policy and the JSC "Bread of Ukraine." This commission solicited wholesale tenders for fertilizer from natural gas suppliers (presumably in cooperative ventures with fertilizer facilities). The awards were to be made on cost and quality bases. At this mission's departure from Ukraine, neither the successful bidders, the bid prices, nor the prices to be charged farmers (in terms of agricultural produce equivalents) had been released.

This tender process has the potential of injecting a degree of competition into the natural gas market supplying the fertilizer market by breaking the regional supply monopolies and ultimately lowering prices of fertilizers to farmers. The stated goal of GOU officials was to lower the cost of natural gas from US $83/Mnm^3 to US $66/Mnm^3.

The disturbing features of the decree or scheme include:

1. It extends state control of the fertilizer market and may be used to exclude emerging private distributors. Both "Bread of Ukraine" and "Agrokhimcentre" are widely viewed as privatized in name only. The 1.2 million mt of nutrients target is double the total amount of fertilizer used in the Ukraine in 1996 (1997 data are not officially available but is expected to be roughly equal to the 1996 level). This would provide little "room" in the market for private distributors. The target of 1.2 million mt is widely held by most (including tender commission members) to be

"overly ambitious" and "unattainable." However, it will serve as a threat to potential private competitors.

2. The paper privatization of "Bread of Ukraine" and "Agrokhimcentre" appears to be an effort to meet the "letter of the law" of conditionalities imposed by donors to reduce state purchases or participation in agricultural markets. Officials admitted to such in discussions. This implies the GOU does not have a commitment to creating an open market.
3. The emphasis on natural gas firms as fertilizer suppliers tends to support the rumors that many of the partners in the JSC fertilizer companies are really thinly-veiled "shadow" representatives of gas suppliers. This suggests there is substantial opportunity for collusion and rent-seeking.
4. The lack of price specifics or agricultural produce exchange equivalents (barter terms) given state procurement history is a concern. The common practice is for contracts not to specify the prices or barter terms when fertilizer is taken but official "hints" suggest a favorable grain to fertilizer relationship. However, by harvest time and repayment to the state, which must be repaid first, the terms of trade favor fertilizer. The ratios were to have been announced but had not been made public by October 31, 1997. Rumors are that the barter rates will be indexed to the Grade 3 winter wheat:ammonium nitrate (AN) ratio and the unofficial "leaked" price will be 1 mt wheat:1 mt AN. Given AN was wholesale priced at US $106/mt wholesale and wheat was trading in US $165-$170/mt range, it would appear that the trade terms favored fertilizer by a significant margin. Agrokhimcentre reported US $5-$7/mt transportation cost with all unloading and transfer charges to the farm to be paid to the purchaser. This would suggest a farm-level price of US $128-$130/mt AN. If this rough calculation is representative as believed, the terms of trade would still favor fertilizer considerably. The US $106/mt AN was supposed to reflect US $83/Mnm^3 natural gas. At US $66/Mnm^3, the Bread of Ukraine scheme "hoped for" gas price, terms of trade would favor fertilizer by additional US $10/mt. This still leaves suppliers or the state, via Bread of Ukraine, a substantial margin for rent-seeking.

Most disturbing of the entire pricing process is the lack of transparency and the inordinate power the state has to extract potentially high relative prices or values. This distorts signals and masks the parastatals' inefficiencies.

3.2 The State as Dominant Market Player

The fertilizer sector continues to be dominated by the state in both production and distribution. Of the six (6) major nitrogen producers two (2) are wholly state-owned and four (4) are open joint stock companies. One of the four, Revne AZOT, is held by the state (91%) and the employees and pensioners (9%); no shares have been sold. No official information could be collected on the other three, so these may have a greater percentage of private ownership. One complex, Cherkassy "AZOT," is listed on the Kiev Stock Exchange. There is considerable speculation that Russian natural gas suppliers and traders own significant shares of these three plants but this was not validated.

The state, via the MOAIC's Ukragrokhim, was reported to have distributed 97% of the fertilizer in 1996 and 93%-97% in 1997. Ukragrokhim's distribution apparatus was recently spun-off as the JSC "Agrokhimcentre" and will be the sole fertilizer distributor for the Bread of Ukraine scheme in 1998. No information was available on the state/private ownership of the JSC but "Agrokhimcentre" officials left no doubt it was still state-owned and -operated down to the raion level.

Ukragrotechservice, the fuel, lubricant, spares, machinery, and custom farming services provision arm, is still wholly state-owned.

State Property Fund Officials report that while 84% of the 3,894 agricultural service enterprises targeted for privatization met the technical definition of privatization (70% non-state ownership) they do not consider anyone to be truly private, i.e., allowed to make independent business decisions. They note shares of stock of one firm owned by another JSC that itself is largely state-owned is considered as non-state owned in meeting the 70% hurdle rate.

In total, the GOU is the dominant market player from an agricultural sector perspective. And that can be extended to most of the large state and collective farms that have been "privatized" but still operate as state-owned operations.

3.3 Privatization Without Capitalization

The privatization process thus far has been effective in distributing land claims and asset shares to first claimants. However, there has not been attendant capitalization that would support debt retirement and provide critically needed investment and operating capital. Given the large social overheads, the lack of any mechanism to reward initiative on these large farms, declining productivity, and predatory state pricing in the input and output markets, many of these farms are not able even to meet current obligations much less retire debt so the debt load continues to grow. The farms (and farm service enterprises) are in positions analogous to the U.S. Deep South sharecroppers at the turn of the century; however, in the Ukraine the government is the company store.

Democratization is a long way from privatization and an infusion (or transfusion) of affordable operating capital, without state control, will be necessary to break the cycle.

3.4 Paradigm Changes

There is no doubt the Ukrainian fertilizer industry existing today evolved under a paradigm that is no longer valid. Plant locations and process choices were largely based on raw material sources and use decisions centrally directed for the benefit of the entire Soviet Union. This situation no longer exists to any significant extent. The paradigm has shifted. The industry must be rationalized in terms of domestic and international market realities for both fertilizer and agricultural products. However, as long as the state is a major market player, the bureaucratic tendency will be to postpone the process.

There are also significant paradigm change implications from the marketing infrastructure perspective. The railway system, grain assembly and processing facilities, etc., were designed (or evolved) to meet the command decisions of the FSU. The spatial location and distribution of facilities are not geared to efficiently and effectively service today's domestic or international markets.

Given current effective domestic demand for both agricultural produce and fertilizer, there appears to be substantial excess capacity. This is confirmed by observations that at least 25% of the land resources are currently idled and the fertilizer industry (N, P_2O_5, and K_2O) is operating at 50%

of capacity or less. On the farming side, the lack of a land market to give guidance to resource use decisions, combined with the distortion in product prices due to state participation in both input and output markets, is stalling movement towards the economic adjustment that will be needed. The marginal competitiveness of the fertilizer industry in terms of the international market is also being masked by state participation. If Ukraine is to capitalize on its significant resource endowment and technical capabilities via globalization of its economy, significant restructuring of its infrastructure and economic adjustment in the production sector will have to be made. This will require significant new investment. In a capital-short economy such as Ukraine this becomes a most formidable task. The reality of the situation can to a large extent explain the conservative calls for a return to the "good ole days."

3.5 Agricultural Technology Development and Technology Transfer

It was observed that this study mission is of the opinion Ukraine has the scientific and technical expertise in nutrient monitoring and management to support a market-driven agriculture. However, there is a need to refurbish and modernize research facilities, restock supplies, and make the investments to protect and nurture the human resource component. It is logical to assume that as paradigm shifts will necessitate adjustments in the structure, organization, and operation of Ukrainian agriculture and the fertilizer industry serving it, a new agricultural research agenda will have to be developed and implemented to service the restructured service. It is imperative this process begin as soon as possible in order that research can lead the adjustments rather than follow and react.

While the research and development base exists, there is no articulated system for technology transfer, i.e., there was no formal extension service under the former Soviet system. In a simplified sense, under the FSU scientific information flowed to a central authority where it was assimilated and recommendations developed, which were then directed to the farms as commands. Some mechanism for technology transfer, either public or private, will have to be implemented. This is especially important when the backgrounds of the new groups of private farmers (and those to emerge) are considered. Very few of these new farmers have the experience in managing farm operations or in performance of production agricultural activities. The new farmers may well have the entrepreneurial drive to participate in a market-driven economy, but they will have to be empowered by access to the

information and decisionmaking framework(s) to process the information in order to succeed. The lack of an effective technology transfer provides a niche that private distributors can exploit to attract market share (customers) and add value to their products and services.

A restructuring of the scientific resources devoted to agricultural research and monitoring will be required since the previous system included obvious duplications that functioned to minimize regional integration. The monitoring requirements of a market-driven economy are much lower than those of a command system. (Simply, competition will provide the rewards or penalties for poor decisions — responsibility rests with the entrepreneur.) This restricting could furnish much of the human resource needs for technology transfer with appropriate skills development.

3.6 Importance of Countervailing Power on "Political Cover"

Countervailing power, originating from either the state, oblast, or raion administrators, was observed to be a common denominator to every private enterprise enjoying any measure of success. Connections are a must to offset and deflect the power of the entrenched and formidable established bureaucracy ("apparatus") and remnants of the command system. These relics of the former command system may be vulnerable to true commercial competition, but what they lack in business acumen they more than make up for in political clout. Political interference and favoritism is a part of the culture that must be factored into business strategy over the foreseeable future.

3.7 Agricultural Policy

No readily discernible, comprehensive, official agricultural policy or policy process could be identified. If such exists, these are not transparent. It appears that agricultural policy is piecemeal, *ad hoc*, and reactive rather than proactive. However, it must be recognized that until a consensus forms on the choice of economic system and the appropriate role of government in such a system, little can be expected in terms of agricultural policy formation and implementation.

A brief review of the fertilizer-oriented portions of the "National Program on the Development and Revival of the Agricultural Sector — Years 1996-2005" was conducted to acquire policy insight. The strategy (plan) does stress sustainability issues by addressing erosion, resource saving and waste

management technologies, extensive use of animal and plant manures, and biological pest management.

From a mineral fertilizer perspective, the plan calls for increasing applications to 4.2 million mt of nutrients by 2005. This level is 15% below peak use in the mid-1980s, and closely corresponds to the rate of overuse reported. Since this level of use is not projected until 2005, the plan implicitly recognizes agriculture will have to experience a significant restructuring and economic adjustment. The plan also projects development of domestic phosphorus and potassium resources by 2005 and is decidedly based on self-sufficiency.

However, the plan has remained a "paper plan" and is long on targets and short on details as to the means by which these ends will be achieved. It seems to beg policies (and money) to implement it. It appears to be more of a command system artifact rather than a instrument of use in marshalling competitive forces.

3.8 Fertilizer Products to Support Proper Nutrient Management

The product mix is narrow but the materials observed were generally of acceptable quality. This is especially true for the AN and urea. There are reports that some phosphate products (primarily SSP and ammoniated SSP) and the potash products have been produced as powders or when granulated tended to deteriorate rapidly. This complicates handling increasing shrinkage and contributes to application inefficiencies.

The fertilizer manufacturing industry is primarily geared to supply the basic materials. There is basically only one $N:P_2O_5:K_2O$ ratio produced, a 17-17-17. The product mix does not lend itself to practicing proper nutrient management or soil test-based fertilization. The basic nature of the limited product line and the lack of downstream processing such as bulk-blending is not conducive to custom formulation for specialty crops nor to facilitate incorporation of secondary and micronutrients into fertility programs. It has already been noted that the dramatic decreases in mineral and organic fertilizer use since independence is mining soil fertility and stressing the crops revealing secondary and micronutrient deficiencies.

Ukraine has the basic soil testing laboratory infrastructures and technical expertise to support soil test-based nutrient management. There are laboratories in every oblast, but operations have been dramatically downsized due to the lack of reagents and money to maintain staff and equipment.

3.9 Farming Practices

Tillage practices appeared to be heavily weighted to conventional plowing (turning over of the soil) with little attention given to stubble or groundcover management. Plowing up and down slopes was commonly observed. In addition, crop residues are used extensively for fodder and livestock bedding. These practices expose the soil to the elements for long periods resulting in significant erosion.

The adoption of no-till, limited till, or stubble mulching practices where appropriate would result in conserving not only soil and petroleum resources but also could play an important role in dealing with radioactive contamination from the Chernobyl accident. A map identifying areas of radioactive contamination is provided as **Figure 2**. Constant turning of the soil keeps the contamination in the upper layer of soil rather than naturally migrating down through the soil profile below the root zone. Coupling nutrient management with limited tillage systems holds particular promise for radioactive contaminant management.

Potassium and calcium blocks or serves as antagonists to caesium and strontium retention. Caesium and strontium are taken up by plants by the same mechanism as potassium and calcium, respectively. A potassium-calcium carbonate containing fertilizer or a potassium fertilizer-lime amendment combination coupled with a reduced tillage, or preferably a no-till system, could be an effective strategy. It would reduce erosion, retain the contaminated soil in place, and allow the contaminants to migrate down through the profile to below the 20- to 25-cm root zone. Some reports suggest nitrogen may activate or hasten caesium and strontium-90 uptake. If accurate, this would even increase the benefits that would accrue to the adoption of integrated reduced tillage and total nutrient management practices.

3.10 Registration Process

The process for registration of agricultural chemicals in Ukraine has been summarized by and is available from the Commercial Service, Embassy of the United States of America. A copy is provided in **Appendix V**. This document was compared with the experience of three private firms importing and selling fertilizer in Ukraine.

Private dealers report the process has taken 3 years to get their products certified for sale and that registration is for a maximum of 5 years with renewal subject to possible re-evaluation. These firms indicate that "problems" are lessened where the fertilizer materials are already certified for use in Ukraine or use of a brand name is avoided. One firm reported success in obtaining an Experimental Use Period (EUP) license and will use the interim to develop the field and vegetative data for registration and certification. The cost of the process could be relatively high since the costs of state trials, tests, and registration procedures must be paid by the applicant. For a 5-year certificate the cost of the application and license would be US $7,500 *plus* costs of field tests.

While this mission does not suggest that protection of the environment be relaxed, it is of the opinion that fertilizers, especially those of commodity status in international markets, do not warrant the same certification procedures (and expenses) as pesticide products. However, the existence of the regulatory structure that may be subject to government interference injects a degree of risk into the operating environment. This is especially true when the government is a major market player and has demonstrated a proclivity for interference as is the case of Ukraine. Relaxation of the process would give impetus to the development of a private distribution system. This will become increasingly important as the Ukrainian fertilizer industry will have to turn to imports of phosphate and potassium raw material and finished products. This is an opportunity to break the real or potential protectionism.

3.11 Fertilizer Exports

Consistent data series on fertilizer production and exports in the Ukraine are difficult to assemble and verify. The difficulty arises in part due to the fact that fertilizer production and use is reported on both a mineral or nutrient basis and on a product basis. The situation is further compounded by the fact that anhydrous ammonia use or exports are not included in any of the

available fertilizer data reports. It is known that both Ukrainian and Russian ammonia are exported from Ukraine, but the public record does not indicate that proportion by country of origin. This latter point makes it extremely difficult to rationalize capacity data. Additionally, data series on the Ukrainian industry are short because independence from the former Soviet Union is only 6 years old and the economic system has been in disarray over the entire period, resulting in severely distorted fertilizer production and use patterns. The net effect is that any fertilizer data series should be used with extreme caution.

The services of the Ukraine Institute of Agrarian Economy were utilized to provide data on the production, export, and import of mineral fertilizers in the Ukraine. The Institute's findings are presented in **Table 15** and are believed reasonably accurate. However, since there are no data available on stock positions and carryovers, the interpolation of supply and implied use is distorted — especially for nitrogen use in 1994 and 1995. In these years, exports exceeded production. It is rational to assume that exports in excess of production actually came from material stockpiled as consumption fell dramatically with economic collapse but production continued to operate under command system signals. This scenario is highly plausible since world prices for fertilizer, especially for nitrogen, had risen significantly and provided Ukrainian producers with the opportunity to liquidate stocks. Production response to domestic and international market signals has been lagged, but it appears the adjustment had largely been made in both production and stocks by 1996 as the calculated supply agrees with that of other sources.

Concern has been expressed that urea and ammonium nitrate fertilizers were exported at the expense of use by Ukrainian agriculture for the last 5 years. There is no information available to support that position. To the contrary, available information suggests that had the policy environment provided the economic incentives for farmers to use fertilizer and the means to finance its purchase, Ukrainian material would have been supplied as demanded. However, exports have provided producers with the opportunity to earn hard currency to pay for raw materials imported and the funds to finance repairs, maintenance, and retrofitting. Rumors abound that revenues generated from exports were diverted and not repatriated. However, the chaotic economic conditions make it impossible to confirm or support such rumors surrounding the domestic supply and export situation.

The apparent stabilization of the Ukrainian fertilizer sector, *albeit* at a much lower level and under a very different organization and structure than prevailed before independence, suggests the distortions are slowly being eliminated. The problem is that the signals and incentives to both fertilizer production and use had become so distorted under the previous command system that the economic adjustment required has been cataclysmic in nature, leaving both devotees of the command system and the open market dissatisfied.

Costs of production estimates suggest that Ukrainian urea and ammonium nitrate are only marginally competitive on a full cost basis on the international market at prevailing natural gas prices and confirmed efficiencies, if competitive at all. It is fully anticipated that the concern over exports of materials at the expense of domestic consumption will be reduced as the agricultural economy improves and market forces are allowed to operate.

3.12 Response to Specific Tasks and Responsibilities in TOR

This section responds to specific tasks in the numerical order as contained in the TOR. Paragraphs listed below as 3.1-3.14 respond directly to the task or identifies where the response is covered in the report. Given the change in emphasis of the nature of the study, not all points in original TOR could be adequately addressed.

3.1 Economic and Energy Policy Framework as it Relates to the Fertilizer Sector: (1) Present an overview of the economic and current energy policy as it impacts the fertilizer industry, particularly pricing, and especially as to how it is affecting the availability of fertilizer to farms, (2) Review policy changes undertaken since 1989 and determine their impacts on the fertilizer and agricultural sectors, and (3) Identify key policy reform areas to restructure the fertilizer sector consistent with economic reform policies.

(1) Addressed in 2.4, 2.6, **Appendix II**, and 2.7 (especially 2.7.2 and 2.7.3).

(2) Too broad given change in emphasis. Critical policy changes handle throughout report.

(3) Addressed in 2.7.3.1 - 2.7.3.5, 3.3, 3.4, and 3.7.

3.2. Review the GOU plan outlined under the National Agricultural Program. Under this program *"GOU controlled prices in 1995-96 on domestically produced material technical input equipment, fertilizer, plant protection agents, and electricity. To remove price controls, steps were then to be taken to demonopolize suppliers by creating enterprises that will provide inputs on a competitive basis."* Based on interviews with farmers, agricultural chemical distributors, appropriate GOU officials, and donor organizations, conduct an analysis of the GOU proposed plan, its implementation, and progress to date.

Addressed in 2.7.1, 2.7.2, 2.7.3, 2.7.4, 3.1, and 3.2.

3.3. Analyze current trends in fertilizer use and impact on crop production in relation to the production, marketing, and/or distribution system in Ukraine. *Analyze impact of the present scenario of declining fertilizer use and exports on lost national productivity, income, and/or foreign exchange earnings. Compare this with the scenario of optimal fertilizer use to maximize farm productivity and proportionately reduced fertilizer exports.*

Estimated impact of use decline in terms of wholesale fertilizer prices and physical yields of selected crops addressed in 2.8.2, 2.9, and 3.11. However, requirement for definitive analysis of this item is beyond the timeframe of this mission.

3.4 Describe and assess the existing distribution system for both the domestic and international markets. This will include the analysis of policy restraints impacting on the distribution system and provide alternative solutions for overcoming the constraints.

Addressed in 2.5, 2.6.1 - 2.6.5.

3.5. Develop representative analysis of the cost of production, distribution, and marketing under a free-market scenario for the principal fertilizer materials. Also, using these farm prices, furnish an analysis of the economics of fertilizer use for the principal crops and farming systems. Include relevant taxes and administrative controls in these illustrative analyses.

Addressed in 2.6, 2.7, and **Appendix II** to extent manageable.

3.6. Identify ways to promote the rational and environmentally sound production and use of fertilizer through analysis and dissemination of fertilizer information.

Addressed in 2.7 and 3.5.

3.7. Describe other donor programs and pilot projects such as the Cargill Bulk-Blending Project and the AP II input supply and service centers as well as the planned pilot areas where USAID project activities are being consolidated for maximum impact. Define the nature and scope of this assistance and develop linkages between these programs and the contractor proposed plan of action.

3.8. The team should investigate other private sector proposals for the fertilizer sector in Ukraine. Such cases as the Norsk-Hydro fertilizer manufacturing and port rehabilitation, a Cargill investment in fertilizer production, and others that the team may identify. A brief analysis of problems and the status of the proposal is expected.

Cargill's bulk-blending facility is located in Marinka, Donetsk Oblast. Cargill's Kiev Office was visited and the project reviewed. The bulk-blending facility became operational late in the 1997 spring fertilizer season. Approximately 1,000 tons of bulk blends was marketed, primarily to Cargill's own seed production program. The fertilizer operation is integrated into a full service agricenter from input to output marketing and processing. At present Cargill is working with 20 to 30 farms and is developing relationships with suppliers of basic fertilizer materials to avoid direct confrontation. Virtually all sales are in-kind and require successive barter transactions until monetization is accomplished domestically or through international trade (the preferred option to avoid the VAT). Cargill is implementing a customer-oriented marketing program built on traditional ag input marketing techniques. Cargill's strategy closely matches the option recommended.

Norsk Hydro (NH) has been active in Ukraine for 5 years and in the fertilizer market for the past 2 years. It sells Ukrainian fertilizers (urea, phosphate, and NPKs) and imported NPK fertilizers. Norsk Hydro's experience is that clearance for importation of fertilizer takes 3 years with field and vegetative tests. Norsk Hydro is pursuing joint ventures with Ukragrokhim facilities being privatized at the raion level as an entrée into the existing distribution system. The firm is using a modified commercial credit program based on 50% prepayment (cash and product) but has no plans to employ 100% credit in marketing program. Currently the main clientele is large state farms, but the smaller private farmers are viewed as a better credit risk. The operation is not yet profitable. Norsk Hydro believes in the agricultural potential but future participation depends on the speed with which the economy is opened. Norsk Hydro has no plans to produce fertilizers in Ukraine. In April 1996 Norsk Hydro entered into a joint venture setup to build and operate a fertilizer terminal in Yuzhnyy. Norsk Hydro had a 24.5% stake for a US $15.2 million for equipment and work, and local partners were to put up no money in return for obtaining permits and political cover. In December 1996 after a US $5 million investment, Norsk Hydro was expelled from the project and currently is attempting to recover its US $5 million investment.

RHG Raiffeisen began operations in 1995 selling inputs to barley and potato producers on large farms and exporting in-kind payments. It is now dealing with all crops and harvesting equipment. The firm sources some nitrogen fertilizer in Ukraine but imports P_2O_5, K_2O, and phosphate, potash, and NPKs (17-17-17, 11-11-11, and 12-12-12). Imports face the 3-year clearance process and high taxes (a 5% border duty, a 20% border VAT, and the regular 20% VAT). The firm currently uses 2 of 12 staff members to deal with the bureaucracy. The firm reports competitors are needed for "security" because of potential government interference. The firm is following the general option suggested but does not appear to be inclined to develop the linkages for political cover.

3.9. The team will also discuss the goals and objectives of the recommended action plan with the Ukrainian counterpart institutions such as the Ministry of Industry (MOI) and the Ministry

of Agriculture and Food (MOAF). The team would solicit their comments as to how the proposed actions would supplement efforts to create enterprises that will provide inputs on a competitive basis. The team should review marketing transactions that utilize deferred payment or crop contracts and the policy implications of such transactions.

Discussions with MOI and MAIC (formerly the Ministry of Agriculture and Food) to gather information were futile and the team was basically dismissed from interviews. No followup discussions were held to review findings or suggestions. It was discovered that no official GOU clearance had been given for conduct of this mission.

3.10. There are major registration procedures for agricultural crop protection chemicals and other products. The registration process can last up to 3-4 years. The team will review these registration, licensing, and other requirements for fertilizer dealerships and for import/export of fertilizers.

Addressed in 3.10 and **Appendix V**.

3.11. The team will check closely the GOU's plans and actions regarding abandoning the creations of Agrotechnology and will make appropriate recommendations regarding specific steps to completely privatize both Ukragrotechservice and Ukragrokhim including the administrative and management support that will be needed for these privatized industries.

Addressed in 3.1 and 3.2. No specific plans to **completely privatize** Ukragrotechservice and Ukragrokhim could be identified. The agrochemical distribution arm of Ukragrokhim had been privatized in August 1997 as JSC "Agrokhimcentre," but available evidence suggests it has been strictly a paper privatization to date.

3.12. A special review will be made of the planned joint or consolidated pilot project areas along with the Citizen Network for Foreign Affairs joint-venture companies and their local

private input distributors and recommendations will be made as to what is needed to increase private sector distribution of fertilizer.

This was not addressed as a separate task because of obvious overlap with other tasks.

3.13. Review World Bank, IMF, USAID conditionalities and after assessment provide the status and consider additional conditions that are needed to move Ukraine to a fully privatized agriculture input production, marketing, and distribution system.

To meet World Bank (WB) conditionalities on removal of export duties and indicative prices on live animal skins, legislation has been proposed and rejected four times. This issue is viewed by the WB as a key to preventing export duties on other commodities.

The conditionality on competitive grain procurement to encourage private participation was not initially successful. Now the thrust is for privatization of 400 elevators, roughly 25% of the country total. To date only 100 have been privatized and the vast majority are paper privatizations only. JSC "Bread of Ukraine" is part of paper privatization.

The third conditionality on halting payment-in-kind requirement by state is not being pursued. The conditionalities not met on land reform include streamlining procedures for obtaining land and assets, removing the moratorium on no sale in first 6 years of ownership, and creating a single and establishing a unified registry of ownership rights. Conditionalities to privatize 2,000 farms and 1,000 agricultural sector businesses have been accomplished on paper. However, the team found few are actually privatized, i.e., able to make independent business decisions. There are two other conditionalities considered by the team to be key to privatization of the input complex: (1) establishing a land market and (2) implementing an output market reform.

3.14. In carrying out this project, the team will meet with (1) appropriate Ministries who have authority and oversight on the production, marketing, and distribution of fertilizers in Ukraine;

(2) fertilizer plant managers and distributors, both government and private, in at least two oblasts to seek their opinion about improving access of fertilizers to Ukraine agriculture; (3) a representative sampling of farms about the nature of the problems and how this can be resolved; (4) U.S. contractors and grantees working with farmers and agribusiness community; and (5) other donor organizations providing TA to the agricultural sector.

See list of contacts made in **Appendix I**.

4.0 Summary and Recommendations

4.1 Summary

While Ukraine has the agricultural resources and the technical fertilizer knowledge base to support evolution of a market-driven agroindustrial complex, the general and agricultural economies are in virtual disarray. Since independence (1991) fertilizer use, both mineral and organic, has fallen precipitously (roughly 90%), and this fact is reflected in the 40%-45% decline experienced in agricultural production. The protracted period of economic turmoil following collapse of the former economic system and the lack of a market-friendly policy environment are delaying the economic adjustments necessitated by shifts in the paradigm under which the existing fertilizer production, distribution, and use system evolved.

Unfortunately there are no easy solutions to complex problems. Before competitive forces can be employed to improve fertilizer use and consequently agricultural production, a market-facilitating macro environment, both economic and legal, must first be established. In terms of agriculture and fertilizer, the position that needs to be resolved is the appropriate role of government. The state continues to be the dominant player, and this presence is the major constraint on the evolution of a demand-driven market system. While there have been some moves toward privatization in the agroindustrial complex, these are primarily paper privatizations and the resulting firms in general do not have the authority to make business decisions independent of the political apparatus. The relevant question is what can be done to marshall competitive forces for benefit in this environment.

4.2 Recommendations

4.2.1 Production Sector Opportunities — Given the current situation, this mission visualizes few opportunities for attracting major investments into fertilizer production, distribution, and use that would inject significant competition into the Ukrainian market. The key operative words are "*major investments — that would inject competition.*" There is no doubt that the industry is looking for potential investors as a way to raise capital for retrofitting and modernization, but it is much less clear how much competition this would inject. In fact, improvements in performance may consolidate the state's position. However, since the Western potash resources have export potential, this may offer

the most promising investment opportunity and facilitate economically rational import substitution. More importantly this could provide a pressure point where selective investments could be levered into legal, political, and economic reforms.

4.2.2 Distribution System Opportunities — Conversely, there are opportunities presented by the narrow product range available, the need for improving nutrient management, and the need to avoid blunt confrontation of the establishment. Bulk-blending facilities included in a total farm service center, with both upstream and downstream linkages, show considerable promise. This is the most common strategy already being employed. The complete package service center approach lessens the potential for state interference. The approach does increase financial exposure, but it provides the opportunity to develop strong customer ties and be in a position to capitalize should the Ukraine become a true open market. Farm service centers should include a healthy measure of extension education since Ukraine has no formal technology transfer system. This feature would not only facilitate technology transfer and adoption but would also develop customer loyalty and provide for customer feedback — a feature sorely missing in the old system. The farm center approach would not reduce the necessity of providing in-kind or commercial credit in the short term but should make the process more manageable and move toward gradual establishment of a program of creditworthiness.

The full service farm centers would not have to be "green field" developments. The existing distribution system does have some facilities with investment value that are progressive, have at least some measure of customer focus, and are cash-short enough to be amenable to entering joint ventures. There will be a need to identify such oblast or raion centers and very selectively seek joint ventures with those with the resource endowments, social disposition, and local countervailing power or political cover that will give the highest probability of success. The value of countervailing power or political cover to potential success should not be underestimated.

Full service centers can provide the opportunity to bring a number of services and product suppliers together for risk sharing. Bulk blending to soil test-based crop requirements can avoid blunt

confrontation of the established products and provide the opportunity to utilize a local (Ukrainian) product sourcing — especially for nitrogen.

In Western Ukraine cooperatives could provide the business structure framework for developing farm service centers.

4.2.3 Improvements in Registration Process — Fertilizers, especially those of commodity status in international markets, do not warrant the same certification procedures (and expenses) as pesticide products. Relaxation of this process will give impetus to the development of a private distribution system and lessen the potential for state interference. This is a change for which donors should exert pressure.

4.2.4 Market Information — There is the need to facilitate the development, publication, and dissemination of fertilizer market information. This should include timely assessments of the domestic and international market conditions, verifiable price data on inputs and outputs, transportation and custom service rates, and reports of unscrupulous market activities. Efforts that make market transactions more transparent will increase the efficiency and effectiveness of the market through competitive pressures. Without major reforms nothing else would do more to inject competitive forces into the agricultural input market than providing verifiable economic market information aimed at improving the quality of decisionmaking.

4.2.5 Establishment of Commercial Credit for Agriculture — A serious constraint to the growth of the private sector participation in providing inputs to Ukrainian agriculture is the lack of commercial credit. The system suffers from a critical cash shortage necessitating in-kind credit and the resulting high costs of barter transactions. There is a need to inject operating capital into the system and move toward encouraging commercial lenders to enter this potentially profitable field. However, there is the attendant need to break the "loan is a gift" mentality that currently prevails in Ukraine.

The establishment of a land market will greatly facilitate the emergence of a commercial credit system as well as increase the efficiency of resource allocation decisions. Donors should continue to press for this reform.

4.2.6 The Appropriate Role of Government — There is a definite need to assist the GOU in developing an appreciation of the appropriate role of government in a market economy. The GOU policy appears to be reactive and *ad hoc*. There is a particular need to assist the GOU in developing an appreciation for dynamic and proactive policy. Development and implementation of a policy dialogue process will assist the GOU in understanding that the government has a significant role to play even under reform to the most open fertilizer markets. However, it (the GOU) will have to be led from dependence on the model of government as a dominant market force to one in which government creates and sustains a market-friendly environment. This will be a slow and frustrating process, but one that is necessary to distinguish policy from politics. The public policy educational model of Issue → Alternatives → Consequences could be used to help government officials evaluate policy issues and tradeoffs. Donors should stress the analysis dimension of a policy dialogue process.

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Table 1. General Information on the Agricultural Soils of Ukraine

Information	Units	Quantity
Approximate total area of agricultural soils	million hectares	43.0
Cultivated land	million hectares	34.3
Hay and pasture lands	million hectares	7.0
Perennials	million hectares	1.1
Approximate distribution of all arable lands in Ukraine		
- Forest	Percent	10.0
- Forest-steppe	Percent	40.0
- Steppe	Percent	50.0
Soils have degraded due to:		
- Area of country cultivated	Percent	57.5
- Soils washed	million hectares	10.0
- Wind eroded	million hectares	5.0
- Acid soils	million hectares	9.7
- Saline and salty	million hectares	4.1
- Humus loss (organic matter), max over 25 years	Percent	0.0
- Radioactive contamination (approx)	Percent	25.0
- Heavy metals, pesticides and other pollutants	—	—
Soils subject to erosion	million hectares	17.0
The Chernozem "black soils"		
- World's supply of Chernozem soils in Ukraine	Percent	26.0
- Ukraine soils comprising Chernozem soils	Percent	57.0
- Area occupied by Chernozem variety soils (total)	million hectares	24.8
- Area occupied by Chernozem variety soils (cultivated)	million hectares	22.2

Chernozem soils are located in the Forest-steppe and Steppe climate zones

Source: M. Koslov and E. Dohodiuk, personal communication, 1997.

Table 2. The Chernozems — Extent, Organic Matter Content, and Main Macro- and Microelements in Ukrainian Black Soils (Contents in Arable Stratum)

Item	Units	Typical Black Soils	Podzol Black Soils	Degraded Black Soils	Common Black Soils	Southern Black Soils	Other Black Soils	Total
Arable	ha ('000)	7,290.8	2,029.6	1,352.4	9,078.6	3,257.7	1,787.7	24,796.8
Cultivated	ha ('000)	6,847.9	1,754.9	1,142.6	8,328.1	2,984.8	1,153.2	22,211.5
Organic matter	%	4.0	3.9	—	4.4	3.5	—	—
Common nitrogen	%	0.24-0.27	0.20	—	0.25-0.26	0.19	—	—
Gross phosphorus	mg/100 g	113.2	107.8	—	121.0	129.0	—	—
Gross potassium	%	1.93-2.38	2.17-2.20	—	1.96-2.28	2.19	—	—
Gross Microelements Content								
Mn	mg/kg soil	569-683	692	—	508-593	844	—	—
Zn	mg/kg soil	54-71	52	—	55-61	69	—	—
Si	mg/kg soil	22-24	20	—	22-34	31	—	—
Co	mg/kg soil	18-20	16	—	19-23	13	—	—
B	mg/kg soil	12-13	17	—	38-42	36	—	—
Mo	mg/kg soil	2.8	2.7	—	2.4-3.7	2.4	—	—

Source: M. Koslov, personal communication, 1997.

Table 3. Cropped Area: Total Grain and Selected Agricultural Crops, Ukraine, 1986-96

Year	Total Grain	Winter Wheat	Winter Rye	Maize	Sugar Beets	Sunflower	Potatoes
	('000 ha)						
1986	16,194	5,710	571	2,783	1,647	1,502	1,515
1987	15,560	5,341	622	2,424	1,665	1,543	1,500
1988	15,897	6,528	586	2,324	1,653	1,577	1,469
1989	15,256	6,945	539	1,851	1,637	1,621	1,468
1990	14,522	7,549	517	1,223	1,605	1,626	1,433
1991	14,571	6,977	487	1,457	1,549	1,585	1,533
1992	13,816	6,294	498	1,137	1,631	1,630	1,705
1993	14,221	5,726	493	1,331	1,629	1,637	1,534
1994	14,151	5,740	506	1,234	1,485	1,784	1,376
1995	13,982	5,757	512	1,149	1,448	2,000	1,252
1996	13,248	5,747	627	693	1,390	1,900	1,572

Source: World Bank, 1994; USDA, May 1997; and Agrarian Institute (JSC Agroincom), 1997.

Table 4. Gross Agricultural Production: Total Grain and Selected Agricultural Crops, Ukraine, 1986-96

Year	Total Grain	Winter Wheat	Winter Rye	Maize	Sugar Beets	Sunflower	Potatoes
	('000 mt)						
1986	41,506	18,377	1,000	8,011	37,970	2,463	21,410
1987	48,061	19,615	1,374	8,308	42,962	2,580	18,863
1988	45,369	21,685	1,055	8,638	42,112	2,648	13,510
1989	51,212	27,371	1,298	7,026	51,917	2,748	19,308
1990	51,009	30,348	1,259	4,737	44,246	2,571	16,732
1991	38,674	21,134	981	4,747	36,168	2,311	14,550
1992	38,537	19,473	1,156	2,851	28,183	2,127	20,277
1993	37,041	21,770	1,180	3,786	33,717	2,075	21,009
1994	32,383	13,857	941	3,654	27,604	1,784	16,102
1995	31,620	16,273	1,208	2,725	29,400	2,000	14,648
1996	25,966	13,333	1,000	1,836	25,500	1,900	18,400

Source: World Bank, 1994; USDA, May 1997; and Agrarian Institute (JSC Agroincom), 1997.

Table 5. Average Yields: Total Grain and Selected Agricultural Crops, Ukraine, 1986-96

Year	Total Grain	Winter Wheat	Winter Rye	Maize	Sugar Beets	Sunflower	Potatoes
	(Centners per ha)						
1986	26	32	17	29	230	16	141
1987	31	37	22	34	258	17	126
1988	29	34	18	37	255	17	92
1989	34	39	24	38	317	17	132
1990	35	40	24	39	276	16	117
1991	27	30	20	33	234	15	95
1992	28	31	23	25	194	13	119
1993	32	38	24	28	222	13	133
1994	22	24	22	30	185	9	117
1995	23	28	21	24	203	14	116
1996	20	23.2	18	26	183	NA	117

Source: World Bank, 1994; USDA, May 1997; and Agrarian Institute (JSC Agroincom), 1997.

Table 6. Comparison of Actual Rail and River Transportation Rates and Estimated Highway Truck Transportation Costs, Ukraine, 1997

Material	Origin City	Destination City	Samples of Freight Charges			Estimated Highway Trucking Cost			
			Rail Freight	Freight & VAT 20%	Freight[a]	Distance	Basis	Distance	Freight
			(UHR/mt)	(UHR/km)	(US$/mt)	(road km)	(1.17 UHR/km & 22 mt load)	(road miles)	(US $/mt)
Rail Transportation									
Ammonium Nitrate	Severodonetsk	Ternopil	14.68	17.62	9.52	1,150	60.64	713	32.78
Aqua Ammonia	Severodonetsk	Ternopil	25.74	30.89	16.70	1,150	60.64	713	32.78
UAN 32%	Gorlovka	Sumy	22.20	26.64	14.40	450	23.73	279	12.83
Ammonium Nitrate	Rivne	Lviv	16.67	20.00	10.81	300	15.82	186	8.55
Dry Bulk	Severodonetsk	Lviv	25.00	30.00	16.22	1,250	65.91	775	35.63
MAP	Rivne	Donetsk	23.13	27.76	15.01	1,064	56.10	660	30.33
Urea	Odessa	Kiev	18.50	22.20	12.00	480	25.31	298	13.68
Urea	Odessa	Cherkassy	13.88	16.66	9.01	453	23.89	281	12.91
Dry Bulk	Liuboml (Polish border)	Kiev	21.58	25.90	14.00	462	24.36	286	13.17
Dry Bulk	Chop (Hungarian border)	Kiev	33.92	40.70	22.00	830	43.76	515	23.66
Urea	Gorlovka	Odessa	9.25	11.10	6.00	788	41.55	489	22.46
Water Transportation (River)									
Dry Bulk	Kherson	Kiev			16.00[b]	584	30.79	362	16.64
Dry Bulk	Kherson	Cherkassy			13.00	381	20.09	236	10.86

a. Exchange rate: US $1.00 = UHR 1.85.

b. Barge rates include a handling charge of US $7/mt of material.

Source: Rail and barge rates are actual observations obtained on field visits.

Table 7. Use of Mineral and Organic Fertilizers to Ukrainian Agriculture and Projected Need for Optimum Plant Nutrition, 1966-1996

Items	Units	Actual Use of Fertilizers											Optimum Requirement	1996 Availability Compared to Optimum (percent)
		1966-70	1971-75	1976-80	1981-85	1986-90	1991	1992	1993	1994	1995	1996		
Mineral Fertilizers														
Total	nutrient mt ('000)	1,740.0	3,044.0	3,593.0	3,825.0	4,900.0	3,800.0	2,100.0	1,500.0	1,162.0	829.0	378.0	5,500.0	6.9
Among them:														
Nitrogen	nutrient mt ('000)	699.0	1,377.0	1,650.0	1,830.0	2,100.0	1,600.0	1,000.0	900.0	610.0	599.0	275.0	2,000.0	13.7
Phosphorus	nutrient mt ('000)	550.0	878.0	880.0	942.0	1,400.0	1,100.0	400.0	200.0	413.0	154.0	73.0	1,850.0	3.9
Potash	nutrient mt ('000)	465.0	859.0	1,063.0	1,053.0	1,400.0	1,100.0	700.0	400.0	139.0	76.0	30.0	1,650.0	1.8
Per ha of cultivated land	nutrient kg	46.0	84.0	46.0	125.0	148.0	126.0	70.0	50.0	42.0	30.5	21.0	184.0	11.4
Organic Fertilizers														
Total	mt ('000,000)	122.0	166.9	217.3	251.4	266.6	225.0	188.0	174.0	128.0	110.0	75.0	340.0	32.3
Per ha of cultivated land	mt	4.0	5.1	7.0	8.5	8.7	7.5	6.3	5.8	4.7	4.0	3.0	11.0	36.4

Source: Ministry of Statistics and Ukragrokhim.

Table 8. Ukraine: Development of Private Farming

Year	No. of Farms	Land Area
		(ha)
1992	14,681	292,000
1993	27,739	558,200
1994	31,893	699,700
1995	34,687	788,500
1996	34,706	822,000
1997[a]	35,400	835,000

a. As of January 1, 1997.

Source: Ukrainian Farmers' Association.

Table 9. Supply and Use of Grain, 1996-1997, USDA and Local Estimates, Ukraine

	USDA Estimates	Local Estimates
Beginning stocks	3,483	3,483
Production[a,b]	30,800	36,000
Imports	60	60
Total supply	34,343	39,543
Exports	1,525	2,000
Domestic consumption	27,651	34,390
Feed and reserve	12,386	16,200
- Waste[c]	1,732	7,200
- Feed[a]	10,654	9,000
Food[a]	10,075	7,000
Seed	3,930	3,930
Industrial	1,260	1,260
Payment to Agricultural Workers[a]	0	6,000
End stocks	5,167	3,153

a. B. Chomiak, Chemonics, September 14, 1997.
b. USDA figure is for clean weight; local estimate uncleaned.
c. USDA at 5.7%; local at 20%.

Table 10. Actual Pieces of Agricultural Machinery Available to Farms, Selected Years From 1990 to 1996 and Percent Change, 1990-1996, Ukraine

Machines and Equipment	Actual Availability				% Change 1990-96
	1990	1994	1995	1996	
	('000 pieces, by 1 January)				(%)
Total tractors	471.2	474.8	452.8	420.6	(10.7)
- Larger tractors	159.9	164.1	155.1	145.8	(8.8)
- Smaller tractors	311.3	311.7	297.7	274.8	(11.7)
Motorized trailer/tractor	362.7	340.1	330.9	312.2	(13.9)
Crawler Tractors	10.2	9.4	6.7	6.3	(38.2)
Mineral fertilizer applicators	47.9	41.5	39.3	36.1	(24.6)
Manure spreaders	44.9	39.6	36.4	33.4	(25.6)
Crop protection chemicals applicators	14.5	12.8	12.3	11.7	(19.3)
Sprayers	27.2	25.4	23.2	22.6	(16.9)
Liquid mixers	9.2	8.7	8.1	2.9	(68.5)
Small-grain seeders	138.6	121.3	117.4	106.7	(23.0)
Large-grain seeders	38.8	38.9	37.9	35.7	(8.0)
Sugar beet seeders	22.5	22.7	22.1	21	(6.7)
Compactors	16.2	10.1	10.1	9.4	(42.0)
Row cultivators	46.2	26.2	26.2	24.2	(47.6)
Potato planters	15.2	12.8	10.9	10.3	(32.2)
Vegetable growing equipment	18.2	15.1	15.8	14.9	(18.1)

Source: Institute of Agrarian Economy

Table 11. Agricultural Equipment, Current Annual Requirements and Costs Plus Priority Equipment Imports, 1996, Ukraine

Machines and Equipment	Annual Need	Cost	Cost of 1996 Imports
	('000 units)	('000 US $)	('000 US $)
Priority need			
Smaller tractors	47.8	262,429	206,100
Crawler tractors	7.7	85,606	96,180
Mineral fertilizer applicators	10.2	65,400	65,400
Manure spreaders	10.6	70,168	56,928
Sprayers	6.6	45,396	60,000
Total priority need		**528,999**	**484,608**
Non-priority need			
Larger tractors	13.8	182,647	
Motorized trailer/tractor	60	214,585	
Crop protection chemicals applicators	3.5	7,110	
Liquid mixers	4.9	28,280	
Small-grain seeders	14.2	7,255	
Large-grain seeders	6.3	67,006	
Sugar beet seeders	3.3	8,025	
Compactors	2.1	4,694	
Row cultivators	2.3	2,435	
Potato planters	1.9	1,422	
Preservatives applicators	4	41	
Vegetable growing equipment	2.1	1,071	
Total all needs		**1,053,570**	

Source: Ukraine Institute of Agrarian Economy.

Table 12. Estimated Value of 1996 Use Deficit Based on Estimated Agronomic Optimum, in U.S. Dollars

Fertilizer Material	1991[a] Production	1996 Production	Estimated Agronomic Optimum	Estimated Domestic Use 1996	Implied Use Deficit	Value of Use Deficit[b]
	(1)	(2)	(3)	(4)	(5)=(3)-(4)	(6)
	('000 nutrient mt)					(US $'000)
Total	4,238.0	2,449.0	4,932.6	378.0	4,554.6	1,609,115
1. Nitrogen Fertilizers	2,819.0	2,083.3	3,288.7	275.0	3,013.8	925,167
Ammonium Nitrate (34%)	753.0	875.0	861.1			
Urea (46.4%)	1,199.0	1,125.0	2,127.5			
Ammonium Sulphate (20.8%)	145.0	110.2	8.9			
Aqua Ammonia (20.5%)	499.0	100.0	75.2			
UAN (32%)	33.0	11.0	37.1			
Others (20.5%)	73.0	6.0	—			
2. Phosphorus Fertilizers	1,282.0	327.0	1,494.9	73.0	1,431.9	647,109
Granular Superphosphate (19%)	102.6	212.6	272.8			
Monoammonium phosphate (11-52-0)	846.1	75.2	988.6			
Nitroamophos (17-17-17)	162.1	36.0	65.1			
Fertilizer mixture (10.5%)	12.8	1.0	7.4			
Diammonium phosphate	51.3	1.2	51.7			
Nitrophos	38.2	1.0	13.1			
3. Total Potash (K_2O)	135.0	39.0	149.0	30.0	119.0	36,890
Potassium magnesium (30%)	91.0	32.4	101.3			
Kainite (10%)	24.0	4.0	27.8			
Potassium sulfate (50%)	20.0	2.6	19.9			

a. 1991 data are presented for reference only.

b. Based on marginal wholesale prices per product ton for 1997 from Ukragrokhim (Table 13).

Source: Ukraine Institute of Agrarian Economy, Tables 6-7, and authors.

Table 13. Declaration of Wholesale Prices for Mineral Fertilizers by Producers, Ukraine, 1997

Name of Product, Destination, Brief Technical Specification	Unit of Measure	Marginal Wholesale Price per Unit of Measure in US $
Liquid Ammonia	metric ton	
- Horlivka Styrol Holding Company		160
- Severodonetsk factory, "Corporation Azot"		160
- Odessa port affiliated factory		160
- JSC "Dniproazot"		160
- Cherkasy JSC "Azot"		160
- JSC "Rivneazot"		165
Urea	metric ton	
- Horlivka Styrol Holding Company		157
- Severodonetsk factory, "Corporation Azot"		157
- Odessa port affiliated factory		157
- Cherkasy JSC "Azot"		157
- JSC "Dniproazot"		157
Ammonium Nitrate	metric ton	
- Horlivka Styrol Holding Company		106
- Severodonetsk factory, "Corporation Azot"		107
- Cherkasy JSC "Azot"		106
- JSC "Rivneazot"		107
Ammonium Sulfate	metric ton	
- Cherkasy JSC "Azot"		55
Liquid Ammonium Fertilizers	metric ton	
- Cherkasy JSC "Azot"		X
Magnesia Potash	metric ton	
- Kalush Holding Company "Oriana"		60
- powdered		75
- granulated		
Granular Mixes	metric ton	
- Rozdilsk factory "Sirka" (Sulfur) 17-17-17		180
- Rozdilsk factory "Sirka" (Sulfur) 16-14-12		175
- Rozdilsk factory "Sirka" (Sulfur) 14-14-14		175
Nitrophos	metric ton	
- Dnipro chemicals factory		210

(Continued)

Table 13. Declaration of Wholesale Prices for Mineral Fertilizers by Producers, Ukraine, 1997 (Continued)

Name of Product, Destination, Brief Technical Specification	Unit of Measure	Marginal Wholesale Price per Unit of Measure in US $
Amophos (MAP, DAP)	metric ton	
- Dnipro chemicals factory		235
- Sumy Corporation "Khimprom"		235
- Crimean Corporation "Titan"		235
- JSC "Rivneazot"		235
Ammoniated Superphosphate	metric ton	110
- Sumy Corporation "Khimprom"		
Superphosphate Granulated	metric ton	
- Vinnitsa state factory "Khimprom"		X
Potash Magnesia - 30	metric ton	93
Kainite	metric ton	
- Stebnik state factory "Polimineral"		38
Ammoniated Water	metric ton	
- Severodonetsk factory, "Corporation Azot"		12
- JSC "Rivneazot"		40
- Cherkasy JSC "Azot"		40
- Horlivka Styrol Holding Company		40

Notes:
1. Wholesale prices are in US $.
2. Purchasers make settlements for the products in Ukrainian currency at the National Bank of Ukraine rate on the day the money is credited to the supplier's account.
3. Wholesale prices are fixed at f.o.b.
4. Wholesale product prices are set for gas price at US $83 per thousand m^3.

Source: Ukragrokhim.

Table 14. Estimated 1996 Yield Loss per Hectare, Selected Crops, Ukraine

Crop	1996		Experimental Optimum						1996 Yield Loss[a]
			Application			Yield			
	Actual Application	Yield	Low	High	Average	Low	High	Average	
	(kg/ha)	(c/ha)[b]	(kg/ha)			(c/ha)			(c/ha)
Wheat	35.0	23.2	190.0	194.0	192.3	34.6	57.0	43.9	20.7
Barley	9.0	16.3	157.0	240.0	190.3	31.1	35.4	33.6	17.3
Grain corn	27.0	26.0	165.0	180.0	172.7	42.0	48.7	44.2	18.2
Sugar beet	104.9	183.0	180.0	960.0	496.3	372.0	532.0	439.0	256.0
Potato	16.3	117.0	242.0	370.0	286.7	182.0	283.0	234.6	117.6

a. Yield loss is calculated as the experimental optimum average yield less the 1996 actual yield.

b. c/ha = centners per hectare.

Sources: Koslov, M.; Ukraine Academy of Agrarian Sciences; B. V. Sakyo et al., "Scientific Base for Crop Production;" B. V. Sayko et al., "Stability of Crop Production;" E. H. Dobrodiuk, "Production of Ecologically Safe Products;" A. A. Bachyla and E. H. Dobrodiuk, "Organic Fertilizers;" and the authors.

Table 15. Production, Export, and Import of Mineral Fertilizers, Ukraine, 1970-96 (nutrient mt '000)

Product	1970	1980	1985	1986-90	1991					1992				
	Prod.	Prod.	Prod.	Prod.	Prod.	Export	Import	Supply	Implied Use	Prod.	Export	Import	Supply	Implied Use
									(kg/ha)					(kg/ha)
Mineral fertilizers (nutrient mt '000)	2,499.0	4,086.0	5,074.0	5,327.8	4,238.0	1,436.3	699.6	3,501.3	127.4	3,261.0	1,704.5	926.6	2,483.1	90.8
1. Nitrogen Fertilizers (product mt '000)	1,396.0	2,403.0	3,220.0	3,424.4	2,819.0	1,055.6	260.9	2,024.3	73.7	2,546.0	1,270.6	0.0	1,275.4	46.7
- Ammonium Nitrate (34%)					2,597.0	1,162.7	0.0	1,434.3	52.2	2,324.7	1,252.2	0.0	1,072.5	39.2
- Urea (46.4%)					2,595.0	891.1	0.0	1,703.9	62.0	2,411.4	1,045.1	0.0	1,366.3	50.0
- Ammonium Sulphate (20.8%)					301.0	223.3	0.0	77.7	2.8	227.0	61.1	0.0	165.9	6.1
- Aqua Ammonia (20.5%)					1,024.0	772.9	0.0	251.1	9.1	874.9	1,115.7	0.0	(240.8)	(8.8)
- UAN (32%)					105.0	105.0	0.0	0.0	0.0	18.8	0.0	0.0	18.8	0.7
- Others (20.5%)					150.2	150.2	0.0	0.0	0.0	12.0	0.0	0.0	12.0	0.4
2. Phosphorus Fertilizers (product mt '000)	703.0	1,344.0	1,563.0	1,696.8	1,282.0	239.3	263.8	1,306.5	47.5	592.0	167.7	0.0	424.3	15.5
- MAP (11-52-0)					553.9	43.7	0.0	510.2	18.6	191.9	50.5	0.0	141.4	5.2
- Granular Superphosphate (19%)					2,294.2	600.8	0.0	1,693.4	61.6	316.6	242.1	0.0	74.5	2.7
- Powdered Superphosphate (50%)					56.2	9.6	0.0	46.6	1.7	833.1	178.1	0.0	655.0	24.0
- NitroAmmophos (17-17-0)					1,017.9	148.8	0.0	869.1	31.6	352.6	0.0	0.0	352.6	12.9
- Mix (10.5%)					854.3	404.9	0.0	449.4	16.4	175.0	0.0	0.0	175.0	6.4
- Diammonium Phosphate (20.5-50-0)					32.8	3.4	0.0	29.4	1.1	11.4	0.0	0.0	11.4	0.4
3. Potassium Fertilizers (product mt '000)	399.0	337.0	290.0	205.2	135.0	117.2	1,095.8	1,113.6	40.5	122.0	49.1	0.0	72.9	2.7
- Potash Magnesia (30%)					193.3	81.9	0.0	111.4	4.1	120.2	57.8	0.0	62.4	2.3
- Kainite (10%)					715.5	710.6	0.0	4.9	0.2	40.1	40.1	0.0	0.0	0.0
- Potash Sulphate (50%)					10.9	6.0	0.0	4.9	0.2	200.3	48.0	0.0	152.3	5.6
Value in US$ ('000)						486,905.0	576,164.0				571,008.0	310,210.0		
Total area cropped (ha '000)									27,484.0					27,332.0

(Continued)

Table 15. Production, Export, and Import of Mineral Fertilizers, Ukraine, 1970-96 (nutrient mt '000) (Continued)

Product	1993					1994					1995				
	Prod.	Export	Import	Supply	Implied Use	Prod.	Export	Import	Supply	Implied Use	Prod.	Export	Import	Supply	Implied Use
					(kg/ha)					(kg/ha)					(kg/ha)
Mineral fertilizers (nutrient mt '000)	2,497.0	1,342.1	6.6	1,161.5	43.0	2,339.9	3,047.7	47	(660.8)	(23.9)	2,221.3	2,212.6	0.0	8.7	0.3
1. Nitrogen Fertilizers (product mt '000)	2,072.0	798.7	0.0	1,273.3	47.1	1,935.0	2,929.5	0	(994.5)	(35.9)	1,871.7	2,050.7	0.0	(179.0)	(6.6)
- Ammonium Nitrate (34%)	1,638.1	688.1	0.0	950.0	35.2	1,496.5	1,368.2	0	128.3	4.6	1,229.8	913.2	0.0	316.6	11.6
- Urea (46.4%)	2,825.1	1,149.5	0.0	1,675.6	62.0	2,594.0	2,199.0	0	395.0	14.3	2,705.4	1,999.6	0.0	705.8	26.0
- Ammonium Sulphate (20.8%)	109.2	9.1	0.0	100.1	3.7	70.5	16.0	0	54.5	2.0	31.8	0.0	0.0	31.8	1.2
- Aqua Ammonia (20.5%)	373.1	117.8	0.0	255.3	9.5	308.1	100.1	0	208.0	7.5	285.0	150.4	0.0	134.6	5.0
- UAN (32%)	15.8	0.0	0.0	15.8	0.6	84.0	47.0	0	37.0	1.3	134.7	86.0	0.0	48.7	1.8
- Others (20.5%)	13.0	0.0	0.0	13.0	0.5	11.5	0.0	0	11.5	0.4	8.7	0.0	0.0	8.7	0.3
2. Phosphorus Fertilizers (product mt '000)	325.0	109.7	0.0	215.4	8.0	324.0	7.5	0	316.5	11.4	294.2	4.1	0.0	290.1	10.7
- MAP (11-52-0)	194.1	95.7	0.0	98.4	3.6	251.5	10.9	0	240.6	8.7	132.3	15.3	0.0	117.0	4.3
- Granular Superphosphate (19%)	281.3	129.7	0.0	151.6	5.6	227.7	0.0	0	227.7	8.2	194.1	0.0	0.0	194.1	7.1
- Powdered Superphosphate (50%)	17.2	0.0	0.0	17.2	0.6	60.3	0.0	0	60.3	2.2	10.5	0.0	0.0	10.5	0.4
- NitroAmmophos (17-17-0)	221.3	86.2	0.0	135.1	5.0	185.8	0.0	0	185.8	6.7	61.8	0.0	0.0	61.8	2.3
- Mix (10.5%)	57.2	8.8	0.0	48.4	1.8	47.3	0.0	0	47.3	1.7	19.5	0.0	0.0	19.5	0.7
- Diammonium Phosphate (20.5-50-0)	48.5	0.0	0.0	48.5	1.8	13.9	0.0	0	13.9	0.5	176.4	0.0	0.0	176.4	6.5
3. Potassium Fertilizers (product mt '000)	100.0	43.5	0.0	56.5	2.1	80.8	2.7	0	78.1	2.8	56.4	15.6	0.0	40.8	1.5
- Potash Magnesia (30%)	237.7	94.7	0.0	143.0	5.3	210.5	9.0	0	201.5	7.3	132.2	52.0	0.0	80.2	3.0
- Kainite (10%)	287.6	115.2	0.0	172.4	6.4	162.3	0.0	0	162.3	5.9	166.5	0.0	0.0	166.5	6.1
- Potash Sulphate (50%)	18.0	7.3	0.0	10.7	0.4	10.4	0.0	0	10.4	0.4	9.0	0.0	0.0	9.0	0.3
Value in US$ ('000)		449,604.0	2,211.0				1,020,980.0	15,745				741,221.0	0.0		
Total area cropped (ha '000)					27,011.0					27,667.0					27,180.0

(Continued)

Table 15. Production, Export, and Import of Mineral Fertilizers, Ukraine, 1970-96 (nutrient mt '000) (Continued)

Product	1996				
	Prod.	Export	Import	Supply	Implied use
					(kg/ha)
Mineral fertilizers (nutrient mt '000)	2,450.0	1,974.0	22.5	498.5	19.7
1. Nitrogen Fertilizers (product mt '000)	2,083.1	1,943.1	2.5	142.5	5.6
- Ammonium Nitrate (34%)	1,458.9	1,525.3	0.0	(66.4)	(2.6)
- Urea (46.4%)	2,689.9	2,155.4	0.0	534.5	21.1
- Ammonium Sulphate (20.8%)	24.9	0.0	0.0	24.9	1.0
- Aqua Ammonia (20.5%)	214.2	0.0	0.0	214.2	8.5
- UAN (32%)	67.9	0.0	0.0	67.9	2.7
- Others (20.5%)	14.0	0.0	0.0	14.0	0.6
2. Phosphorus Fertilizers (product mt '000)	327.2	16.1	6.8	317.9	12.6
- MAP (11-52-0)	309.4	34.7	0.0	274.7	10.9
- Granular Superphosphate (19%)	310.8	0.0	0.0	310.8	12.3
- Powdered Superphosphate (50%)	0.0	0.0	0.0	0.0	0.0
- NitroAmmophos (17-17-0)	82.7	0.0	0.0	82.7	3.3
- Mix (10.5%)	14.8	0.0	0.0	14.8	0.6
- Diammonium Phosphate (20.5-50-0)	21.5	0.0	0.0	21.5	0.8
3. Potassium Fertilizers (product mt '000)	39.0	14.8	13.2	37.4	1.5
- Potash Magnesia (30%)	94.9	20.0	0.0	74.9	3.0
- Kainite (10%)	75.2	16.0	0.0	59.2	2.3
- Potash Sulphate (50%)	13.1	0.0	0.0	13.1	0.5
Value in US$ ('000)		661,290.0	7,538.0		
Total area cropped (ha '000)					25,296.0

Source: Ukraine Institute of Agrarian Economy and authors.

Note:

The calculated supply data in 1994 and 1995 obviously reflect carryover from previous years. This indicates that the supply data in previous years may be overstated, although they are similar to data from other sources. Another source indicates domestic use in 1994 and 1995 to be 42 kg/ha and 30.5 kg/ha, respectively. Additionally, data may have been incorrectly reported. For example, observers report 4-5 million ha has been idled in 1996 due to lack of capital and restrictive government policies. This is not reflected in the reported data, and this would overstate per cultivated ha use rates.

Figure 1. Administrative Districts, Major Railroads, and Major Cities of Ukraine

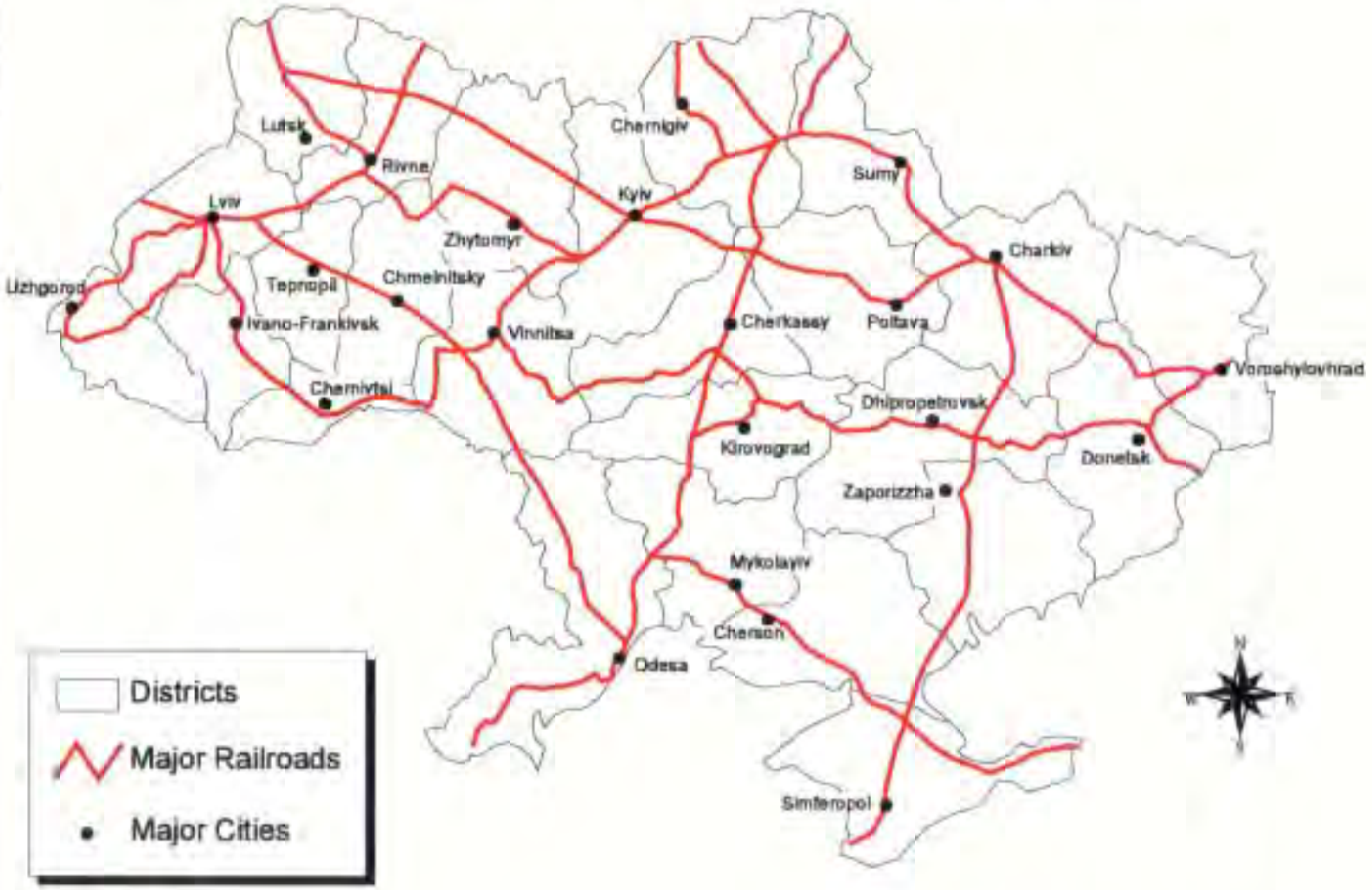
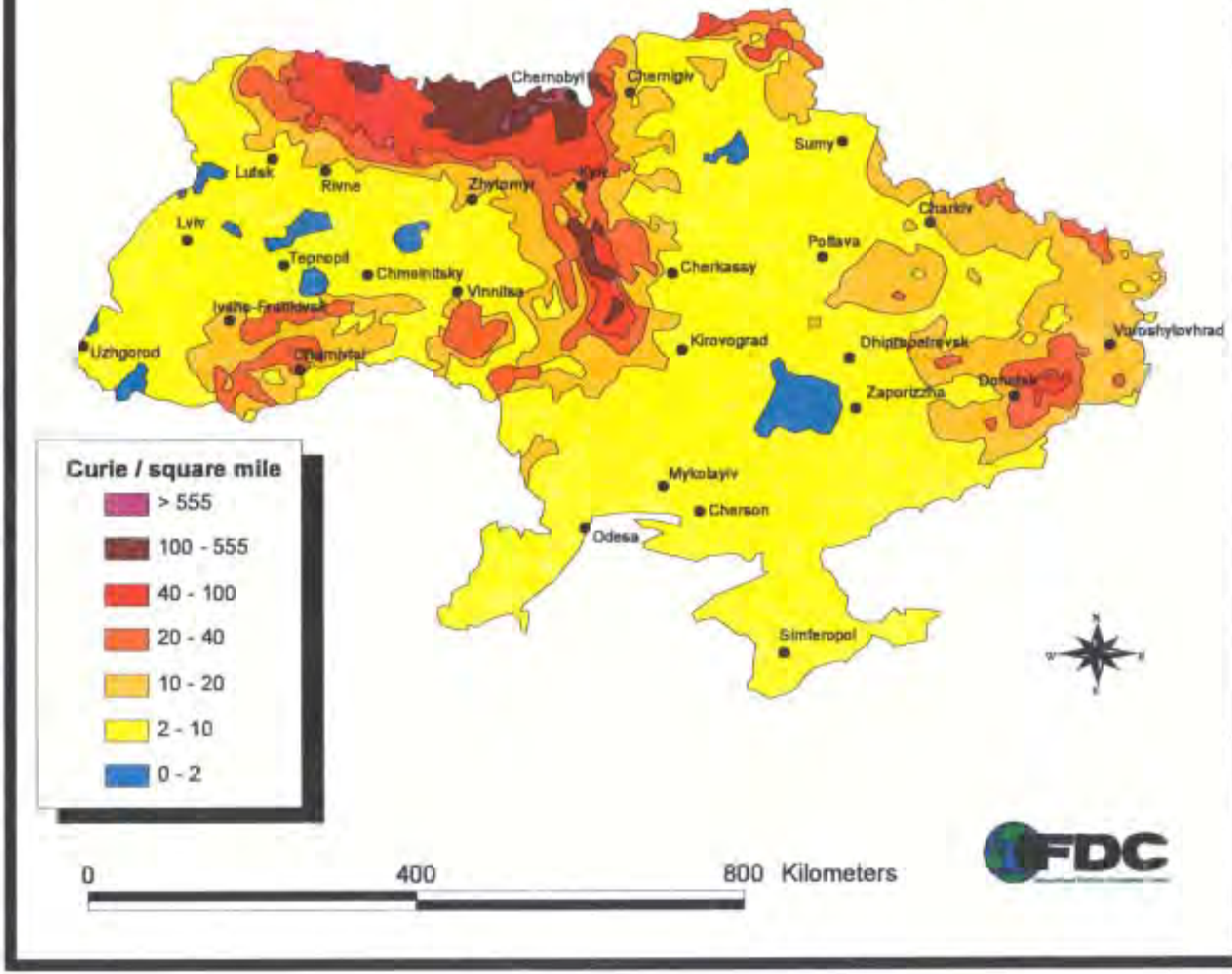


Figure 2. Radiation Contamination of Soils in Ukraine - 1996



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Appendix I

List of Entities and People Interviewed

Appendix II

Capacity of Ukrainian Nitrogen Industry and Comparative Fertilizer Production Costs

Appendix II

Capacity of Ukrainian Nitrogen Industry and Comparative Fertilizer Production Costs

This Appendix contains estimates of Ukraine's nitrogen capacity and the production costs of selected fertilizer materials in the United States and the Ukraine. The estimates were developed for reference purposes in assessing the relative competitiveness of Ukrainian production given known parameters. This appendix includes:

- Ukraine's nitrogen production capacity, September 1997.
- Estimated U.S. and Ukraine ammonia production costs at two natural gas prices — US $83 and US $66/Mnm^3.
- Estimated U.S. and Ukraine urea production costs at two natural gas prices — US $83 and US $66/Mnm^3.
- Estimated U.S. and Ukraine production costs for sulfuric and phosphoric acid.
- Estimated U.S. and Ukraine UAN (32%) production costs at two natural gas prices — US $83 and US $66/Mnm^3.
- Estimated U.S. and Ukraine MAP production costs at two natural gas prices — US $83 and US $66/Mnm^3.
- Estimated U.S. and Ukraine DAP production costs at two natural gas prices — US $83 and US $66/Mnm^3.
- Estimated Ukraine NPK (17-17-17) production costs.
- Estimated international ammonia and urea production costs, October 1997.

Table II-1. Ukrainian Nitrogen Production Capacity, September 1997

Ammonia

Company	Annual Capacity
	(mtpy N)
A. J.S.C. "Azot" Cherkassy	
1. Cherkassy I	164,000
2. Cherkassy II	164,000
3. Cherkassy III	164,000
4. Cherkassy IV	164,000
5. Cherkassy V	164,000
6. Cherkassy VI	369,000
Subtotal	**1,189,000**
B. JSC "Concern Stirol"	
1. Gorlovka I	369,000
2. Gorlovka II	369,000
3. Gorlovka III	369,000
Subtotal	**1,107,000**
C. "Dnepro Azot" Open-End Investment Company	
1. Dneprodzerzhinsk I	370,000
2. Dneprodzerzhinsk II	370,000
Subtotal	**740,000**
D. "Association Azot" State Manufacturing Enterprise	
1. Severodonetsk I	369,000
2. Severodonetsk II	369,000
Subtotal	**738,000**
E. Open JSC "Rivneazot"	
1. Rivne I	164,000
2. Rivne II	164,000
3. Rivne III	164,000
Subtotal	**492,000**
F. Odessa Seaport Plant	
1. Grigoryevka I	369,000
2. Grigoryevka II	369,000
Subtotal	**378,000**
TOTAL	**4,644,000**

Table II-1. Ukrainian Nitrogen Production Capacity, September 1997 (Continued)

Urea

Company	Annual Capacity
	(mtpy urea)
A. J.S.C. "Azot" Cherkassy	
1. Cherkassy I	330,000
2. Cherkassy II	330,000
Subtotal	**660,000**
B. JSC "Concern Stirol"	
1. Gorlovka I	454,000
2. Gorlovka II	371,000
Subtotal	**825,000**
C. "Dnepro Azot" Open-End Investment Company	
1. Dneprodzerzhinsk I	330,000
2. Dneprodzerzhinsk II	330,000
Subtotal	**660,000**
D. "Association Azot" State Manufacturing Enterprise	
1. Severodonetsk I	330,000
2. Severodonetsk II	330,000
Subtotal	**660,000**
F. Odessa Seaport Plant	
1. Grigorievka I	330,000
2. Grigorievka II	330,000
Subtotal	660,000
TOTAL	**3,465,000**
(Nitrogen as Urea = 1,593,900 mtpy N)	

Ammonium Nitrate

Company	Annual Capacity
	(mtpy urea)
A. J.S.C. "Azot" Cherkassy	
1. Cherkassy I	520,000
2. Cherkassy II	520,000
Subtotal	**1,040,000**
B. JSC "Concern Stirol"	
1. Gorlovka I	720,000
Subtotal	**720,000**
C. "Association Azot" State Manufacturing Enterprise	
1. Severodonetsk I	450,000
Subtotal	**450,000**
D. Open JSC "Rivneazot"	
1. Rivne	520,000
Subtotal	**520,000**
TOTAL	**2,730,000**
(Nitrogen as AN = 928,200 mtpy N)	

Table II-2. Estimated U.S. and Ukraine Ammonia Production Costs

At two natural gas prices — US $83 and US $66/Mnm^3

Basis: $83/Mnm^3 cost for Ukraine Natural Gas is equivalent to $2.61/million Btu based on a natural gas of 8,000 kcal LHV which is close to the average for Russian gas delivered in the Ukraine. Plants 1,000 mtpd or larger are assumed.

Anhydrous Ammonia	U.S.	Ukraine
Natural Gas Cost	**$2.61/million Btu**	**$83/Mnm^3**
Natural Gas Usage	37.18 million Btu/mt	1,370 nm^3/mt
Natural Gas Cost	$97.04	$113.71
Other Cash Costs	$21.00	$23.00
Total Cash Costs	**$118.04**	**$136.71**
TFI Average Ammonia Cost for Plants 1,000 stpd and Over — 1996 (for reference)		
Total Cash Costs	**$120.04**	
Natural Gas Cost	**$2.07/million Btu**	**$66/Mnm^3**
Natural Gas Usage	37.18 million Btu/mt	1,370 nm^3/mt
Natural Gas Cost	$76.96	$90.42
Other Cash Costs	$21.00	$23.00
Total Cash Costs	**$97.96**	**$113.42**
TFI Average Ammonia Cost		
Total Cash Cost	**$99.96**	
New M. W. Kellogg Technology Ammonia plants KRES/KAAP which uses 27.5 million Btu/mt or 866 nm^3/mt		
Natural Gas Costs	**$2.07/million Btu**	**$66/Mnm^3**
Natural Gas Usage	27.5 million Btu/mt	866 nm^3/mt
Natural Gas Cost	$56.93	$57.16
Other Cash Costs	$18.00	$18.00
Total Cash Costs	**$74.93**	**$75.16**

Note: Other cash costs are lower for the new process because there is no reforming furnace and the synthesis gas compressor has only one case. Capital and operating costs are also lower.

Mnm^3 = One thousand normal cubic meters.
Million Btu = One million Btu.

Table II-3. Estimated U.S. and Ukraine Urea and Prilled Ammonium Nitrate Production Costs

At two natural gas prices — US $83 and US $66/Mnm^3

Basis: Although the Ukraine urea plant uses more ammonia per ton of urea than the U.S. plants due to frequent shutdowns, .587 t/t is used for both plants. Higher operating costs are assumed for Ukraine because of maintenance costs and higher frequency of shutdowns.

	U.S.	Ukraine
Urea		
Ammonia Usage	**.587 t/t**	**.587 t/t**
Natural Gas Cost	**$2.61/million Btu**	**$83/Mnm^3**
Ammonia Costs	**$118.04**	**$136.71**
Ammonia Cost	$69.29	$80.25
Other Cash Costs	$33.00	$35.00
Total Cash Costs	**$102.29**	**$115.25**
Ammonia Usage	**.587 t/t**	**.587 t/t**
Natural Gas Costs	**$2.07/million Btu**	**$66/Mnm^3**
Ammonia Costs	**$97.96**	**$113.42**
Ammonia Cost	$57.50	$66.58
Other Cash Costs	$33.00	$35.00
Total Cash Costs	**$90.50**	**$101.58**
Prilled Ammonium Nitrate		
Ammonia Usage	**.470 t/t**	**.470 t/t**
Natural Gas Cost	**$2.61/million Btu**	**$83/Mnm^3**
Ammonia Cost	**$118.04**	**$136.71**
Ammonia Cost	$55.48	$64.25
Other Cash Costs	$34.00	$36.00
Total Cash Costs	**$89.48**	**$100.25**
Ammonia Usage	**.470 t/t**	**.470 t/t**
Natural Gas Cost	**$2.07/million Btu**	**$66/Mnm^3**
Ammonia Cost	**$97.96**	**$113.42**
Ammonia Cost	$46.04	$53.31
Other Cash Costs	$34.00	$36.00
Total Cash Costs	**$80.04**	**$89.31**

Table II-4. Estimated U.S. and Ukraine UAN 32% Solution Production Costs

At two natural gas prices — US $83 and US $66/Mnm^3

	U.S.	Ukraine
UAN 32% Solution		
Ammonium Nitrate Usage	**0.442 t/t**	**0.451 t/t**
Urea Melt Usage	**0.351 t/t**	**0.351 t/t**
Natural Gas Costs	**$2.61/million Btu**	**$83/Mnm^3**
Ammonia Costs	**$118.04**	**$136.71**
Ammonium Nitrate Cost	$36.90	$41.66
Urea Melt Cost	$33.80	$38.35
Other Cash Costs	$4.00	$6.00
Total Cash Costs	**$74.70**	**$86.01**
UAN 32% Solution		
Ammonium Nitrate Usage	**0.442 t/t**	**0.442 t/t**
Urea Melt Usage	**0.351 t/t**	**0.351 t/t**
Natural Gas Costs	**$2.07/million Btu**	**$66/Mnm^3**
Ammonia Costs	**$97.96**	**$113.42**
Ammonium Nitrate Cost	$35.38	$44.31
Urea Melt Cost	$31.77	$35.65
Other Cash Costs	$4.00	$6.00
Total Cash Costs	**$71.14**	**$85.97**

Table II-5. Estimated U.S. and Ukraine Sulfuric Acid and Phosphoric Acid Production Costs

	U.S.	Ukraine
Sulfuric Acid Basis: The Ukraine plant contacted plans to buy recovered sulfur from Russia at a cost of $62/mt.		
Sulfur Cost	**$67/mt**	**$62/mt**
Sulfur Usage	**.328 t/t**	**.350 t/t**
Sulfur Cost	$21.98	$21.70
Other Cash Costs	$5.00	$10.00
Total Cash Costs	**$26.98**	**$31.70**
TFI Average Sulfur Costs for Plants under 1.0 million mtpd (for reference)		
Sulfur Usage	**.323 t/t**	
Sulfur Cost	$21.64	
Other Cash Costs	$4.40	
Total Cash Costs	**$26.04**	
Phosphoric Acid Basis: Rozdil Ukraine procures rock from Apatite, Russia on the Kola Peninsula which was reported to cost $78/mt laid into the plant. The rock yields 39% P_2O_5. Florida rock is priced at $27.50/mt for these projections.		
Sulfuric Acid Usage	**2.85 t/t**	**2.85 t/t**
Phosphate Rock Usage	**3.562 t/t**	**2.82 t/t**
Sulfuric Acid Cost	$76.88	$90.35
Phosphate Rock Cost	$97.96	$219.96
Other Cash Costs	$18.00	$20.00
Total Cash Cost	**$192.84**	**$330.31**

Table II-6. Estimated U.S. and Ukraine MAP Production Costs

At two natural gas prices — US $83 and US $66/Mnm^3

Note: The U.S. produces 11-52-0 primarily, but the Ukraine produces a 12-52-0 so the production cost will not be exactly comparable.

	U.S.	Ukraine
Monoammonium Phosphate		
Ammonia Usage	**.143 t/t**	**.156 t/t**
Phosphoric Acid Usage	**.536 t/t**	**.536 t/t**
Sulfuric Acid Usage	**.022 t/t**	**.022 t/t**
Natural Gas Cost	$2.61/million Btu	$83/Mnm^3
Ammonia Cost	$118.04	$136.71
Phosphoric Acid Cost	$192.84	$330.31
Sulfuric Acid Cost	$26.04	$31.70
Ammonia cost	$16.88	$21.33
Phosphoric Acid Cost	$103.36	$177.05
Sulfuric Acid Cost	$0.57	$0.70
Other Cash Costs	$15.00	$20.00
Total Cash Cost	**$135.81**	**$219.07**
Monoammonium Phosphate		
Ammonia Usage	**.143 t/t**	**.156 t/t**
Phosphoric Acid Usage	**.536 t/t**	**.536 t/t**
Sulfuric Acid Usage	**.022 t/t**	**.022 t/t**
Natural Gas Cost	$2.07/million Btu	$66/Mnm^3
Ammonia Cost	$97.96	$113.42
Phosphoric Acid Cost	$192.84	$330.31
Sulfuric Acid Cost	$26.04	$31.70
Ammonia cost	$14.01	$17.69
Phosphoric Acid Cost	$103.36	$177.05
Sulfuric Acid Cost	$0.57	$0.70
Other Cash Costs	$15.00	$20.00
Total Cash Cost	**$132.94**	**$215.44**

Table II-7. Estimated U.S. and Ukraine DAP Production Costs

At two natural gas prices — US $83 and US $66/Mnm^3

	U.S.	Ukraine
Diammonium Phosphate		
Ammonia Usage	**.223 t/t**	**.223 t/t**
Phosphoric Acid Usage	**.4735 t/t**	**.4735 t/t**
Sulfuric Acid Usage	**.011 t/t**	**.011 t/t**
Natural Gas Cost	$2.61/million Btu	$83/Mnm^3
Ammonia Cost	$118.04	$136.71
Phosphoric Acid Cost	$192.84	$330.31
Sulfuric Acid Cost	$26.04	$31.70
Ammonia cost	$26.32	$30.49
Phosphoric Acid Cost	$91.31	$156.40
Sulfuric Acid Cost	$0.29	$0.35
Other Cash Costs	$15.00	$20.00
Total Cash Cost	**$132.92**	**$207.24**
TFI cost for diammonium phosphate as average for all plants for 1996 using calculated cost of ammonia at $118.04	**$133.85 (for reference)**	
Ammonia Usage	**.223 t/t**	**.223 t/t**
Phosphoric Acid Usage	**.4735 t/t**	**.4735 t/t**
Sulfuric Acid Usage	**.011 t/t**	**.011 t/t**
Natural Gas Cost	$2.07/million Btu	$66/Mnm^3
Ammonia Cost	$97.96	$113.42
Phosphoric Acid Cost	$192.84	$330.31
Sulfuric Acid Cost	$26.04	$31.70
Ammonia cost	$21.85	$25.29
Phosphoric Acid Cost	$91.31	$156.40
Sulfuric Acid Cost	$0.29	$0.35
Other Cash Costs	$15.00	$20.00
Total Cash Cost	**$128.44**	**$202.04**
TFI cost using lower ammonia price	**$128.51 (for reference)**	

Table II-8. Estimated Ukraine NPK (17-17-17) Production Costs

Note: Rozdil personnel did not supply the formulation for 17-17-17 but indicated ammonium nitrate was the supplemental nitrogen source.

NPK 17-17-17	Ukraine
Ammonium Nitrate Usage	**.319 t/t**
DAP Usage	**.385 t/t**
K_2O Usage	**.296 t/t**
Filler	
Ammonium Nitrate Cost	$89.31/T
DAP Cost	$207.24/T
K_2O Cost	$74.00/T
Filler	
Ammonia Cost	$28.49
Phosphoric Acid Cost	$79.79
K_2O Cost	$21.90
Filler	
Other Cash Costs	$24.00
Total Cash Costs	**$154.18**

Note: Rozdil personnel reported that the plant earned about 10% profit on products sold. Therefore a list price of $160/mt would yield a manufacturing cost of about $145/mt. This formulation is 17.7-17.7-17.7 which is about 4% over on nutrients. **Adjusting back to 17-17-17 would yield a $147/mt production cost.**

Table II-9. Estimated International Ammonia and Urea Production Costs, October 1997

	USA	Middle East	Venezuela	Russia	Indonesia
Ammonia Production Cost/mt					
Natural Gas	$ 81.23	$ 19.00	$ 19.65	$ 50.00	$ 76.00
Electricity	3.40	2.50	2.50	7.50	2.00
Operating Labor	3.06	3.00	1.80	2.10	2.10
Other Utilities	3.36	1.00	1.00	3.00	2.75
Plant Overhead	4.80	5.00	5.20	6.00	5.00
Maintenance	7.00	7.50	7.50	9.00	7.50
Catalysts	1.09	1.09	1.09	1.09	1.09
Miscellaneous Supplies	0.91	1.15	1.15	1.25	1.10
Taxes & Insurance	1.40	1.40	1.40	1.40	1.40
Depreciation	6.15	6.15	6.15	3.00	6.15
Other	0.33	0.33	0.33	0.33	0.33
Total Costs/mt ammonia	$ 112.72	$ 48.12	$ 47.77	$ 84.67	$ 105.42
Urea Production Cost/mt					
Ammonia	$ 65.94	$ 28.15	$ 28.66	$ 55.04	$ 61.67
Steam	12.84	2.95	2.95	5.89	11.78
Electricity	0.60	0.69	0.40	1.25	0.34
Operating Labor	2.83	3.50	3.00	2.40	1.50
Operating Supplies	0.15	0.25	0.25	0.35	0.20
Rentals	0.11	0.11	0.11	0.11	0.11
Taxes & Insurance	1.00	1.00	1.00	1.00	1.00
Maintenance	11.00	13.00	16.00	19.00	13.00
Plant Overhead	3.06	3.50	3.50	4.00	3.06
Total Costs/mt urea	$ 97.53	$ 53.14	$ 55.87	$ 89.04	$ 92.67

Source: Outreach Division, IFDC, October 1997.

Appendix III

Terms of Reference

Developing a Competitive Fertilizer Marketing and Distribution Network in Ukraine

I. Background

1.1. Over the last 5 years crop yields in Ukraine have declined drastically, in many cases as much as 50% or higher. Although some of this decline is attributed to two successive droughts, a significant production has been lost simply because of declining use of agricultural inputs, particularly fertilizers. In 1989 Ukraine produced about 52 mmt (million metric tons) of all grains. The latest report for 1996 puts this figure to be around 26 mmt, a 50% decrease from the highs of the late 1980s.

1.2. Increased fertilizer prices, inadequate farm-out pricing policies, and the lack of financial resources have led to a collapse in fertilizer use in the region. The Government of Ukraine (GOU) 10-Year (1996-2005) Ukraine National Agricultural Development Program (UNADP) shows that in 1995, on an average, application of fertilizer amounted to only about 30 kg of fertilizer per hectare as compared with 140 kg in 1991. In 1986 Ukraine supplied just under 5.5 mmt of all mineral fertilizers of which the largest amount, almost 65%, was nitrogen fertilizer in the form of urea. Of the remaining fertilizers, about 30% was phosphate based and about 5% was potash based on raw materials from Russia and Mahreb.

1.3. Not only is the overall production reduced by lack of needed fertilizers, but the quality of grains, particularly wheat, is drastically reduced. Most wheat produced in 1996 was grade 5, which is normally used only for animal feed. However, much of this lower grade wheat will almost certainly wind up at state bakeries for bread production.

1.4. The Soviet energy policy relative to the fertilizer industry was formulated on the basis of two major assumptions: (1) that the natural gas, used in production of urea, was abundantly available at

very low prices in the Soviet republics of Russia and Turkmenistan; and (2) that it will continue to remain available in the future. These assumptions are no longer valid for the Ukraine fertilizer production and marketing industry.

1.5. At present the fertilizer manufacturers must pay increasingly high dollar costs of importing natural gas. In 1993, the last year for which reliable records are available, overall fertilizer production in Ukraine had dropped by 54% (sector decreases were [a] nitrogen— 40%, [b] phosphate — 80%, and [c] potash — 60%). This massive implosion in fertilizer production has been further complicated by the fact that the GOU and the companies producing fertilizer, desperate for ready cash and to the detriment of Ukrainian agriculture, find it more lucrative to export to countries such as China and India. During 1993, 1994, and 1995, fertilizer exports as percent of the total production were 98.6, 85.8, and 73.1, respectively. In addition, there are reports that a significant amount of fertilizer reported as "not exported" leaks out to other FSU states through informal channels.

1.6. UNADP reports that Ukraine had available only 829,000 mmt of all mineral fertilizers in 1995, compared with about 4.2 mmt in 1990. Furthermore, UNADP projects that it will be 2005 before the fertilizer availability meets or exceeds 1990 availability levels. However, this projection is considered highly optimistic given current and projected economic realities in Ukraine.

1.7. In the last few years, barter transactions have been hampered by the GOU restrictions on issuing import and export licenses. Furthermore, these transactions have been done by the affiliates of joint ventures with large input supply companies. Thus, smaller and more specialized farms and other enterprises are at a significant disadvantage in acquiring fertilizer.

1.8. The Ukrainian fertilizer sector is characterized by inadequate management, low capacity utilization, excessive loss of product during transport and distribution to the farms, and excessive employment compared with free market industrial standards. During the past 5 years of transition to market-driven economy, these problems have gone largely unattended and have become more critical. Perhaps the most serious problem is the lack of service-oriented fertilizer sales outlets to all classes of farming enterprises. As a result, there is a continued decline in the utilization of fertilizer

production capacity resulting in unfavorable production economics. Effective policies are urgently needed for the establishment of competitive marketing systems to ensure that farmers have access to input and output markets at competitive regional and global norms. Restoration of the fertilizer supply systems will require coordinated projects addressing the issues of marketing, management information systems, mobilization of credit, human resource development, and technical assistance.

1.9. *Overall, the Ministry of Industry (MOI) controls fertilizer production and exports. Ukragrokhim controls distribution within Ukraine. Ukragrokhim supplies inputs largely produced in Ukraine while the Ukraagrobusiness (UAB) supplies some domestically produced inputs but mostly focuses on supply of imported inputs.*

1.10 Although there are several private companies that supply agricultural inputs, including fertilizer, the market share of these private distributors is limited due to the reluctance of foreign input suppliers to provide credit (pre-export finance). Availability of pre-export finance including export license could significantly expand the private distributors' activity in Ukraine. This could be facilitated by the new pre-export guarantee program of the World Bank.

1.11. Under the Agribusiness Partnerships II Project, Cargill will establish a prototype fertilizer bulk-blending facility with integrated soil-testing and prescribed applications. This is a critical area but only a part of the improvements needed in the fertilizer sector.

1.12. On March 25, 1997, the Government announced the creation of a new, government-owned joint stock company called "Agrotechnology." This company would have combined the resources of "Khlib Ukraina," which now controls grain marketing with "Ukragrotechservice," which would supply machinery and equipment and "Ukragrokhim," which would supply chemicals and fertilizer. Thus it appeared that the entire process from agricultural production through input supply and marketing would have been carried out within a closed government system. However, due to pressure from international donors, in the Gore-Kuchma binational meetings held in May 1997 in Washington, Deputy Prime Minister Zubets announced that GOU has abandoned its plan to form Agrotechnology and has decided to privatize most of Khlib Ukraina, Ukraagrokhim, and Ukraagrotechservice.

II. Objective

The purpose of this study is to describe the fertilizer sector in Ukraine with reference to ownership, management, production, marketing, and distribution of different kinds of fertilizers, and outline activities that should be undertaken to help develop a private, market-driven fertilizer industry. Achieving this objective is consistent with GOU's principal goal "to halt decline in agricultural production, provide the government with food security, and attain an acceptable level of food consumption."

III. Scope of Work

The objectives of this study are (1) develop an approach that would help rationalize the fertilizer sector created under a paradigm that is no longer valid, (2) identify policy reform areas, and (3) articulate donor assistance needs that would accelerate domestic consumption and supply through a privatized system. Specific tasks and responsibilities follow.

3.1 Economic and Energy Policy Framework as it Relates to the Fertilizer Sector: (1) Present an overview of the economic and current energy policy as it impacts the fertilizer industry, particularly pricing, and especially as to how it is affecting the availability of fertilizer to farms, (2) Review policy changes undertaken since 1989 and determine their impacts on the fertilizer and agricultural sectors, and (3) Identify key policy reform areas to restructure the fertilizer sector consistent with economic reform policies.

3.2. Review the GOU plan outlined under the National Agricultural Program. Under this program *"GOU controlled prices in 1995-96 on domestically produced material technical input equipment, fertilizer, plant protection agents, and electricity. To remove price controls steps were then to be taken to demonopolize suppliers by creating enterprises that will provide inputs on a competitive basis."* Based on interviews with farmers, agricultural chemical distributors, appropriate GOU

officials, and donor organizations, conduct an analysis of the GOU proposed plan, its implementation, and progress to date.

3.3. Analyze current trends in fertilizer use and impact on crop production in relation to the production, marketing, and/or distribution system in Ukraine. *Analyze impact of the present scenario of declining fertilizer use and exports on lost national productivity, income, and/or foreign exchange earnings. Compare this with the scenario of optimal fertilizer use to maximize farm productivity and proportionately reduced fertilizer exports.*

3.4 Describe and assess the existing distribution system for both the domestic and international markets. This will include the analysis of policy restraints impacting on the distribution system and provide alternative solutions for overcoming the constraints.

3.5. Develop representative analysis of the cost of production, distribution, and marketing under a free-market scenario for the principal fertilizer materials. Also, using these farm prices, furnish an analysis of the economics of fertilizer use for the principal crops and farming systems. Include relevant taxes and administrative controls in these illustrative analyses.

3.6. Identify ways to promote the rational and environmentally sound production and use of fertilizer through analysis and dissemination of fertilizer information.

3.7. Describe other donor programs and pilot projects such as the Cargill Bulk-Blending Project and the AP II input supply and service centers as well as the planned pilot areas where USAID project activities are being consolidated for maximum impact. Define the nature and scope of this assistance and develop linkages between these programs and the contractor proposed plan of action.

3.8. The team should investigate other private sector proposals for the fertilizer sector in Ukraine. Such cases as the Norsk-Hydro fertilizer manufacturing and port rehabilitation, a Cargill investment in fertilizer production, and others that the team may identify. A brief analysis of problems and the status of the proposal is expected.

3.9. The team will also discuss the goals and objectives of the recommended action plan with the Ukrainian counterpart institutions such as the Ministry of Industry (MOI) and the Ministry of Agriculture and Food (MOAF). The team would solicit their comments as to how the proposed actions would supplement efforts to create enterprises that will provide inputs on a competitive basis. The team should review marketing transactions that utilize deterred payment or crop contracts and the policy implications of such transactions.

3.10. There are major registration procedures for agricultural crop protection chemicals and other products. The registration process can last up to 3-4 years. The team will review these registration, licensing, and other requirements for fertilizer dealerships and for import/export of fertilizers.

3.11. The team will check closely the GOU's plans and actions regarding abandoning the creations of Agrotechnology and will make appropriate recommendations regarding specific steps to completely privatize both Ukragrotechservice and Ukragrokhim including the administrative and management support that will be needed for these privatized industries.

3.12. A special review will be made of the planned joint or consolidated pilot project areas along with the Citizen Network for Foreign Affairs joint-venture companies and their local private input distributors and recommendations will be made as to what is needed to increase private sector distribution of fertilizer.

3.13. Review World Bank, IMF, USAID conditionalities and after assessment provide the status and consider additional conditions that are needed to move Ukraine to a fully privatized agriculture input production, marketing, and distribution system.

3.14. In carrying out this project, the team will meet with (1) appropriate Ministries who have authority and oversight on the production, marketing, and distribution of fertilizers in Ukraine; (2) fertilizer plant managers and distributors, both government and private, in at least two oblasts to seek their opinion about improving access of fertilizers to Ukraine agriculture; (3) representative sampling of farms about the nature of the problems and how this can be resolved; (4) U.S. contractors

and grantees working with farmers and agribusiness community; and (5) other donor organizations providing TA to the agricultural sector.

3.15. In order to accomplish this, *IFDC will field for up to four (4) weeks a team of four subject matter specialists* — fertilizer production specialist, policy economist, transportation/distribution specialist, and marketing specialist with significant experience in developing a private, market-driven fertilizer distribution and marketing system in the countries of the former Soviet Union (FSU). IFDC may also recruit a local advisor who has considerable knowledge of the Ukrainian socio-political environment and the fertilizer sector, its organization, and present difficulties. Translators and rental cars will be the responsibility of IFDC. The field work will begin on or about July 15, 1997, and require approximately four (4) weeks.

Overall, the team will conduct an assessment of the fertilizer sector in Ukraine and collaborate with the GOU counterpart institutions in developing an action plan for USAID assistance. The team shall provide a findings seminar for USAID/Kiev (and possibly for key GOU, donor, and private company representatives) at the completion of field work at which time the tentative findings and recommendations will be presented. *The deliverable for the TEAM will be a final report, a draft of which will be due four (4) weeks following completion of the field work in Ukraine.*

IV. Special Instructions/Management Relationships

The team will travel to Ukraine and have a briefing by the USAID/Kiev staff. Dennis Sharma, USAID, or his designee, will coordinate all field work including in-country travel and initial appointments with the appropriate Ministries, fertilizer producers and distributors, and briefings/ debriefings with USAID. IFDC will designate a technical team leader. Additional appointments may be set up by the USAID coordinator or by the technical team leader. A particular effort will be made by the team and/or USAID to assure that the Ukrainian farmers and private distributors are well represented in these interviews. The report specified in Section V shall be the work product and responsibility of the IFDC staff.

V. Justification for Procurement as Subgrant Under the CNFA Cooperative Agreement

CNFA is presently focusing on startup and implementation of the Agribusiness Partnership II program and mobilizing its resources to tackle difficult problems in agricultural input supply and services. IFDC has a strong track record of success in conducting fertilizer-sector analyses and in development of workable plans for establishing a commercially sustainable fertilizer industry. Two key IFDC projects which focused on establishment of a private competitive fertilizer marketing system as the key to fertilizer sector development include Sustaining the Restructures Fertilizer Sector in Albania and the Fertilizer Distribution Improvement Project in Bangladesh — both of these projects focused on policy reform to establish a free market for fertilizer distribution, technical assistance to fertilizer dealers, human resource development, credit system development to facilitate fertilizer inventory management, and the MIS design and development.

Considering that (1) the supply of agricultural inputs is one of the emphasis areas under the Agribusiness Partnership Program, (2) access to and use of fertilizers is critical for significant gains in productivity, and (3) IFDC is one of the cooperators in the AP-II cooperative agreement, it is planned that CNFA will subcontract (or subgrant) IFDC to conduct this study.

VI. Country/Counterpart Concurrence/Clearances

The counterpart for this project is the Ministry of Industry, Ministry of Agriculture and Food, Institute of Agricultural Economics, Ukrainian League of Entrepreneurs in Agriculture, and others.

Appendix III

Terms of Reference

Developing a Competitive Fertilizer Marketing and Distribution Network in Ukraine

Appendix IV

Cabinet of Ministers of Ukraine

On Conditions for Meeting Agricultural Demands for Mineral Fertilizers for 1998 Harvest

DECREE No. 977, September 3, 1997

The Cabinet of Ministers of Ukraine **decrees:**

1. To accept the Proposal of the Ministry of Industrial Policy, Ministry of Economy, Ministry of Finance, Ministry of Agro-Industrial Complex, Ministry of Energy, State Joint Stock Company *Khlib Ukrainy* (Ukraine's Bread), the State Committee for Oil, Gas, and Oil Refining Industry as to identifying on a competitive basis of wholesale suppliers of fertilizers, who in September 1997-June 1998 will provide agricultural commodity producers with mineral fertilizers produced by enterprises of Ukraine's chemical industry, in the amount of 1.2 million tons, including 856 thousand tons of nitrogenous fertilizers, 260 thousand tons of phosphorous fertilizers, 84 thousand tons of potash fertilizers, for resources, food, and commodity grain and other produce of the 1997-1998 harvest. To approve the composition of the commission on organizing and conducting the above contest (attached).

   The Ministry of Energy, the State Committee of Oil, Gas, and Oil Refining Industry shall provide conditions for unimpeded supply, in the event of payment, of mineral fertilizers, electric power and natural gas directly to producing enterprises.

2. The State Joint Stock Company *Khlib Ukrainy* shall issue, and ensure discounting, bills of exchange (hereinafter referred to as "bills") in the amount of Hr 780 million within the cost of the remainder of the grain purchased to state order, in settlement of payments for mineral fertilizers received from suppliers.

   The Main Department of State Treasury shall provide surety for bills issued by the State Joint Stock Company *Khlib Ukrainy* in settlement of payments for received mineral fertilizers. In this case the sum of surety for bills must not exceed the value of the remainder of the grain purchased to state order.

In the event of failure to effect settlement by the bills for which surety was provided by the Main Department of State Treasury, the State Joint Stock Company *Khlib Ukrainy* shall compensate for their cost by realizing the grain from the state resources.

The State Joint Stock Company *Khlib Ukrainy* must ensure — until December 20, 1998 — redemption of bills transferred to suppliers of mineral fertilizers, at the expense of resources received from realization of grain.

3 In accordance with Article 9 of Decree No. 8 of the Cabinet of Ministers of Ukraine of January 21, 1993, "On Collection of Taxes that Were not Paid in Due Time and of Non-Tax Payments" the Ministry of Finance shall grant — within a budget year — a deferment for suppliers of mineral fertilizers in payments to Ukraine's state budget in the amounts taking into account the volumes of mineral fertilizers supplied to agricultural commodity producers in conformity with this decree.

4. The Ministry of Economy, Ministry of Agro-Industrial Complex, Ministry of Finance, Ministry of Industrial Policy, the State Joint Stock Company *Khlib Ukrainy* shall approve — within a 10-day period — the equivalents of exchanging these fertilizers for agricultural produce, including food and commodity grain, meat, animal and vegetable oil, sugar, sunflower, etc., to be agreed upon with the suppliers of mineral fertilizers.

To establish that the equivalents of exchange are to be determined at the *RaiAgroKhim* (district agro-chemical formation) ex warehouse prices for mineral fertilizers (taking into account expenditures for payment of railway tariffs, services connected with delivering and cleaning of railway cars as well as additional charges levied at railway stations of destination, and expenses related to organizational measures) and agricultural produce with value-added tax at the ex warehouse of a purchasing and processing enterprise.

Payment of expenses on delivery and cleaning of cars is to be effected monthly by Supplier of mineral fertilizers according to actual expenses.

Expenses connected with unloading of cars, acceptance, storage and delivery of mineral fertilizers are to be reimbursed by agricultural commodity producers to district agro-chemical formations under separate contracts.

5. The Ministry of Agro-Industrial Complex, the State Joint Stock Company *Khlib Ukrainy* shall ensure the acceptance, processing, storage and shipment of agricultural produce procured in settlement of payment for mineral fertilizers on terms and conditions stipulated for procurement of grain into the state resources.

6. *UkrZa1iznytsya* (Ukrainian railway department) shall ensure priority transportation of mineral fertilizers as well as components and raw materials for their production. The rolling-stock is to be provided on consignor's order without levying any additional charges for delivery of cars that is not provided for by the plan.

7. The Ministry of Agro-Industrial Complex, Ministry of Finance, the State Joint Stock Company *Khlib Ukrainy* jointly with suppliers of mineral fertilizers shall elaborate — within a 10-day period — a procedure for providing agricultural commodity producers with mineral fertilizers for the 1998 harvest.

   To establish that the terms and conditions for implementing this Decree are determined in accordance with the trilateral agreements to be concluded by suppliers of mineral fertilizers, the *UkrAgroKhim* Association, State Joint Stock Company *Khlib Ukrainy* as well as under contracts with agricultural commodity producers.

8. Supervision of implementation of this Decree is to be carried out by First Vice-Prime Minister of Ukraine A. K. Holubchenko.

V PUSTOVOITENKO
Prime Minister of Ukraine

Appendix IV

Decree 977

On Conditions for Meeting Agricultural Demands for Mineral Fertilizers for 1998 Harvest

September 3, 1997

Appendix V

Registration of Agricultural Chemicals in Ukraine

All agricultural chemicals (fertilizers, pesticides, growth stimulants and regulators, and pheromones) are subject to the same regulations of certification and registration.

This activity is administered by the Ukrainian State Chemical Commission.

This registration and certification policy of treating fertilizers the same as pesticides place an unusual burden on the introduction of new fertilizers to Ukraine that might have universal acceptance based on worldwide usage and experience.

A verbal explanation received indicates that there might be some relaxation of the rules if there is recognition of the product as comparable to a product already in use in Ukraine. However, there was not a clear definition of how rigidly it may be applied.

All fertilizer products, domestic or foreign, are subject to the regulations of registration and certification before a new product can be sold, distributed, and used in Ukraine.

The maximum registration period granted is for 5 years with renewal subject to possible revaluation required at the end of the 5-year term.

An Experimental Use Period (EUP) license of 2 years is permitted if the submitted data and circumstances supporting safe use are acceptable to the Commission.

Registrations may be cancelled at any time if new data indicate such action is warranted due to hazardous or toxicological effects of the product.

The evaluation process involves State Field and Production Trials of 1 to 3 years in duration depending on the active ingredients. The principal steps are:

A. **Review of Submitted Data by the Applicant Firm** — Evaluated in view of existing requirements. Applicant must provide analytical methods of determining active hazardous ingredients. Proposals for review must be submitted by December 1 to be included in the in the annual program which is discussed by the USCC in the first half of February. Proposals submitted after December 1 are considered for entry in the trial program for the following year.

B. **Field Trials** — Designed to assess biological efficacy and economic efficiency and compared to similar products already registered.

C. **Production Trials** — Validate biologic and economic efficiency in different areas of Ukraine; define use standards and regulation; and verify acceptability for aerial application, maximum residue levels in food and soil, and effect on air, soil, and groundwater.

D. **Trial Data** — The authorized research is conducted under the direction of the Ukrainian Academy of Agricultural Sciences, Ministry of Health, Ministry of Agriculture, Ministry of Forestry, State Commission of Housing and Communal Services, and supervision of the Ukrainian State Chemical Commission (USCC).

Registration Documentation is a matter of the applicant submitting the following documents not later than 3 months before the USCC plenary meeting.

1. Five copies of the application form available from the USCC.
2. Information on the stability of the product.
3. Availability of the product.
4. List of the existing registered substitutes of the product and economic grounds for this product in Ukraine.
5. State trials data.
6. Recommended regulated use of the product in agricultural production.
7. Toxicological and hygiene assessment of the product and the conclusion of the Ministry of Health on the possibility of registration and areas of application.
8. Methods of determining residues in agricultural crops and food products.

9. Conclusions of the trial contractor experts on the risk assessment of product to aquatic organisms and bees.
10. Preliminary instructions on use, transportation, storage, personal protection, methods of diagnostics in case of poisoning, and first aid treatment.
11. Specimen product label.

Upon completion of all the steps in the process and favorable recommendation by the panels of experts, the USCC issues a Certificate of Registration with a code number for the product and the product is listed in the state register of products allowed for use in agriculture in Ukraine.

The costs of state trials, tests, and registration procedures are financed solely by the applicant.

Preliminary consideration of application form	US $500
Field trials done by USCC authorized agency	Cost unknown
Final payment for registration certificate and number	
5-year Certificate	US $7,000
2-year Certificate	US $5,700
1-year Certificate	US $2,850
To broaden range of application	US $2,000
To register a new recipe	US $2,000
To extend a EUP from 2 to 5 years	US $1,300

The USCC notifies all the other agencies that the product is registered for use and distribution and is cleared for import entry. Application of this complex procedure to fertilizers is unusually burdensome; and the use of pesticides to control insects, weeds, and fungi is usually subject to a different set of regulations in the pursuit of protection to crops, people, and the environment.

Source: The Commercial Service, Embassy of the United States of America.

Appendix V

Registration of Agricultural Chemicals in Ukraine

Appendix VI

Selected Archived Materials/Data

Table VI-1. Climatic Indices of the Territory of Ukraine

Zone	Sum Total of							Days Above		Hydrothermal Factor After Salaninov
	Rainfall			Temperatures Above						
	Over the Year	Over the Cold Period	Over the Warm Period	0	5	10	15	0	15	
	(mm)			(°C)				(°C)		
Forest (average)	564	163	402	2900	2800	2450	1880	246	104	1.36
Forest (range)	550-579	154-172	296-414	2850-2950	-	-	1850-1900	239-253	102-108	1.23-1.43
Forest steppe (average)	522	142	380	3020	2900	2580	1890	248	115	1.2
Forest steppe (range)	505-650	139-170	362-480	2960-3090	2790-3000	2500-2660	1720-2045	240-255	101-116	1.10-1.60
Steppe (average)	438	140	298	3575	3431	3065	2489	261	131	0.85
Steppe (range)	336-480	129-146	206-335	3389-3866	2416-3786	2892-3411	2337-2843	246-285	124-140	0.55-0.96

Source: Ministry of Statistics.

Table VI-2. Harvested Areas, Gross Yield, and Levels of Yield of Winter Wheat in All Categories of Farms of Crimea and Oblasts by Soil-Climatic Zone of Ukraine, 1996

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Among Them		Private Household Plots and Those of Lease-Holders	Private Farms
			Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms		
	Harvested area ('000 ha)					
Ukraine	**5,746.5**	**5,426.2**	**4,791.8**	**634.8**	**208.9**	**111.5**
Forest	**800.0**	**713.8**	**532.6**	**51.2**	**95.6**	**10.5**
Volynska	122.3	102.8	95.1	7.7	18.1	1.4
Zhytomyrska	176.7	154.6	15.8	8.8	21.4	0.6
Zakarpatska	24.5	19.6	16.1	3.5	3.3	1.6
Ivano-Frankivska	51.5	46.1	42.9	3.2	4.6	0.9
Lvivska	146.0	124.0	115.6	8.4	18.5	3.5
Rivnenska	111.1	96.4	91.1	5.3	13.8	0.9
Chernihivska	167.9	170.3	156.0	14.3	15.9	1.6
Forest-Steppe	**2,098.8**	**1,990.2**	**1,762.4**	**227.6**	**80.6**	**28.0**
Vinnytska	256.8	251.9	234.2	17.6	3.1	1.9
Kyivska	252.3	226.4	183.6	42.8	22.2	3.9
Poltavska	340.1	318.3	283.6	34.7	16.2	5.6
Sumska	205.0	194.5	175.6	18.9	6.3	4.2
Ternopilska	160.4	148.9	139.1	9.8	9.2	2.3
Kharkivska	351.9	341.5	273.4	68.1	4.3	6.0
Khmelnytska	232.8	225.9	212.2	13.7	5.1	1.8
Cherkaska	255.0	239.9	220.9	18.9	13.0	2.0
Chernivetska	44.5	42.9	39.8	3.1	1.3	0.3
Steppe	**2,426.9**	**2,722.2**	**2,366.8**	**355.3**	**32.7**	**72.7**
Crimea	252.9	244.6	168.3	76.3	5.3	3.0
Dnipropetrovska	374.2	363.3	325.5	37.8	3.2	7.7
Donetska	293.8	286.3	250.5	35.8	2.1	5.4
Zaporizka	213.0	204.9	158.0	46.9	4.5	3.6
Kirovohradska	307.3	292.4	275.0	17.3	4.4	10.6
Luhanska	261.1	251.7	230.6	21.1	1.2	8.2
Mykolayivska	357.1	344.2	287.5	56.7	0.4	13.1
Odeska	38.6	425.1	396.4	28.7	2.7	10.8
Khersonska	328.9	309.7	275.0	34.7	8.9	10.3

(Continued)

Table VI-2. Harvested Areas, Gross Yield, and Levels of Yield of Winter Wheat in All Categories of Farms of Crimea and Oblasts by Soil-Climatic Zone of Ukraine, 1996 (Continued)

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Among Them		Private Household Plots and Those of Lease-Holders	Private Farms
			Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms		
	Gross yield (centners '000)					
Ukraine	**133,339.2**	**126,637.6**	**112,440.9**	**14,196.7**	**5,138.1**	**1,563.6**
Forest	**16,744.6**	**14,166.7**	**13,161.5**	**1,005.2**	**2,370.6**	**207.8**
Volynska	2,472.4	2,006.1	1,856.2	149.9	439.9	26.8
Zhytomyrska	3,831.1	3,319.5	3,139.7	179.8	502.5	9.1
Zakarpatska	708.3	547.2	453.7	93.5	108.9	52.2
Ivano-Frankivska	845.3	734.4	689.6	44.8	98.9	12.0
Lvivska	3,083.3	2,501.8	2,353.9	148.0	513.8	67.7
Rivnenska	2,292.4	1,932.4	1,826.1	106.2	344.2	15.9
Chernihivska	3,511.8	3,125.3	2,842.3	283.0	362.4	24.1
Forest-Steppe	**59,695.4**	**57,064.1**	**50,596.0**	**6,447.9**	**2,124.6**	**506.9**
Vinnytska	7,568.8	7,469.4	7,001.5	467.9	60.1	39.4
Kyivska	8,172.3	7,466.3	6,136.6	1,309.7	623.0	82.9
Poltavska	10,080.8	9,527.6	8,423.1	1,104.4	448.9	104.3
Sumska	4,200.7	4,010.3	3,576.9	433.3	135.5	55.0
Ternopilska	4,079.5	3,836.0	3,609.2	226.8	203.5	40.1
Kharkivska	9,780.2	9,554.7	7,643.1	1,911.6	119.5	106.0
Khmelnytska	6,229.5	6,106.1	5,810.9	295.2	89.1	34.3
Cherkaska	8,731.6	8,274.0	7,634.5	639.5	417.4	40.2
Chernivetska	852.0	819.7	760.2	59.5	27.6	4.7
Steppe	**56,905.5**	**55,406.9**	**48,663.4**	**6,733.5**	**643.5**	**849.1**
Crimea	4,188.5	4,063.0	2,856.3	1,206.7	87.9	37.6
Dnipropetrovska	8,713.2	8,532.6	7,585.0	947.6	78.4	102.2
Donetska	7,305.8	7,170.7	6,248.4	922.3	51.0	84.0
Zaporizka	4,040.3	3,915.7	3,030.1	885.6	85.0	39.7
Kirovohradska	7,330.5	7,101.1	6,793.7	307.4	82.6	146.8
Luhanska	4,967.2	4,833.6	4,436.4	397.2	24.9	102.7
Mykolayivska	6,457.0	6,323.4	5,356.4	956.9	6.1	127.5
Odeska	8,361.9	8,195.4	7,633.2	562.3	52.8	113.7
Khersonska	5,541.1	5,271.4	4,723.9	547.5	174.8	94.9

(Continued)

Table VI-2. Harvested Areas, Gross Yield, and Levels of Yield of Winter Wheat in All Categories of Farms of Crimea and Oblasts by Soil-Climatic Zone of Ukraine, 1996 (Continued)

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Among Them		Private Household Plots and Those of Lease-Holders	Private Farms
			Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms		
	Harvested area ('000 ha)					
Ukraine	**23.2**	**23.3**	**23.5**	**22.4**	**24.6**	**14.0**
Forest	**20.9**	**19.8**	**24.7**	**19.6**	**24.8**	**19.8**
Volynska	20.2	19.5	19.5	19.5	24.3	18.7
Zhytomyrska	21.7	21.5	21.5	20.3	23.5	14.2
Zakarpatska	28.9	27.9	28.2	26.7	32.9	31.8
Ivano-Frankivska	16.4	15.9	16.1	14.1	21.7	13.3
Lvivska	21.1	20.2	20.4	17.7	27.7	19.4
Rivnenska	20.6	20.0	20.0	20.0	24.9	17.7
Chernihivska	18.7	18.3	18.2	19.7	22.8	14.9
Forest-Steppe	**28.4**	**28.7**	**28.7**	**28.3**	**26.4**	**18.1**
Vinnytska	29.5	29.7	29.9	26.6	19.3	20.9
Kyivska	32.4	33.0	33.5	30.6	28.2	21.3
Poltavska	29.6	29.9	29.7	31.8	27.7	18.6
Sumska	20.5	20.6	20.4	22.9	21.5	13.1
Ternopilska	25.4	25.8	26.0	23.2	22.1	17.6
Kharkivska	27.8	28.0	28.0	28.1	27.6	17.7
Khmelnytska	26.8	27.0	27.4	21.5	17.6	19.2
Cherkaska	34.2	34.5	34.6	33.8	32.2	18.6
Chernivetska	19.1	19.1	19.1	19.0	21.5	14.3
Steppe	**23.4**	**20.4**	**20.6**	**19.0**	**19.7**	**11.7**
Crimea	16.6	16.6	17.0	15.8	16.7	12.5
Dnipropetrovska	23.3	23.5	23.3	25.1	24.3	13.3
Donetska	24.9	25.0	24.9	25.8	24.6	15.5
Zaporizka	19.0	19.1	19.2	18.9	18.8	11.1
Kirovohradska	23.9	24.3	24.7	17.7	18.6	13.9
Luhanska	19.0	19.2	19.2	18.8	20.7	12.5
Mykolayivska	18.0	18.4	18.6	17.1	15.6	9.7
Odeska	19.1	19.3	19.3	19.6	19.7	10.5
Khersonska	16.8	17.0	17.2	15.8	19.6	9.2

Source: Ministry of Statistics.

Table VI-3. List of Recommended Fertilizers for Ukraine

Fertilizer	Chemical Composition	Content (%)
Nitrogenous Fertilizers		
Liquid ammonia	NH_3	82
Hydrous ammonia	NH_4OH	18.0-20.5
Ammonia sulfate	$(NH_4)_2SO_4$	20.8-21.0
UAN	$NH_4NO_3 + CO(NH_2)_2$	20
Ammonium nitrate	NH_4NO_3	34
Urea	$(NH_2)_2CO$	46
Phosphorus Fertilizers		
Granulated superphosphate	$Ca(H_2PO_4)_2 \times H_2O + 2CaSO_4$ with H_3PO_4	21
Phosphate slag	$4CaO \times P_2O_5 + 4CaO \times P_2O_5 \times CaSiO_3$	10-12
Natural phosphorites	$SiO_2 + CaCO_3 + P_2O_5$	5-7
Potash Fertilizers		
Potash chloride	KCl with NaCl	53.6-62.5
Potassium magnesia	$K_2SO_4 \times MgSO_4 \times 6H_2SO_4 \times 6H_2O$	not less than 28
Potash salt (mixed 40%)	KCl + NaCl	not less than 40
Kainite	$KCl \times MgSO_4 \times 3H_2O$, NaCl up to 50%	not less than 14

Source: E. H. Dehodiuk, personal communication, 1997.

Table VI-4. Average Sown Areas, 1991-1996 and Estimated Optimal and Total Mineral Fertilizer Need for All Types of Farms in Ukraine, by Crop (Nutrient)

Crops	Average Sown 1991-96	Optimum	Estimated Need	Including		
				Nitrate	Phosphate	Potash
	('000 ha)	(kg/ha)	('000 mt)	('000 mt)		
Total sown area	31,143.0	160.0	4,982.9	3,288.7	1,494.9	199.3
Cereals including corn	13,662.0	174.0	2,377.2	1,569.0	713.2	95.1
Winter crops	6,805.0	174.0	1,184.1	781.5	355.2	47.4
- Wheat	5,722.0	191.0	1,093.0	721.4	327.9	43.7
- Rye	527.0	173.0	91.2	60.2	27.4	3.6
- Barley	472.0	151.1	71.3	47.6	21.4	2.9
Spring crops	6,937.0	174.0	1,207.0	796.6	362.1	48.3
- Wheat	63.0	190.5	12.0	7.9	3.6	0.5
- Barley	3,446.0	151.0	520.3	343.4	156.1	20.8
- Corn	1,092.0	173.0	188.9	124.7	56.7	7.6
Technical crops	3,597.0					
- Sugar beet	1,484.0	180.4	267.7	176.7	80.3	10.7
- Sunflower	1,798.0	109.0	196.0	129.4	58.8	7.8
- Flax	116.5	150.2	17.5	11.5	5.3	0.7
Potatoes	1,566.0	248.0	388.4	256.3	116.5	15.5
Vegetables	481.0	300.0	144.3	95.2	43.3	5.8
Forage crops	11,392.0	130.0	1,481.0	977.5	444.3	59.2
Fruits and berries	810.0					

Source: Ukraine Institute of Agrarian Economy.

Table VI-5. Extent and Liming Need of Acid Soils in Ukraine, by Soil Type

Soils	pH	Distribution by Soil Type						Total
		Sandy and Loam-Sandy	Subsandy	Light Loam	Average Loam	Heavy Loam	Loam	
Extent of Acid Soils ('000 arable ha)								
Strongly Acid	<= 4.0	39.9	46.9	44.2	14.3	15.4	4.5	165.2
Very Acid	4.1 - 4.5	221.8	136.3	146.6	374.8	141.1	40.8	1,061.4
Average Acid	4.6 - 5.0	341.6	362.1	447.8	498.7	122.6	8.7	1,781.5
Weakly Acid	5.1 - 5.5	252.9	297.5	723.3	908.2	259.4	17.9	2,459.2
Soils close to neutral	5.6 - 6.0	69.9	336.1	515.0	889.9	357.3	28.2	2,196.4
Total		926.1	1,178.9	1,876.9	2,685.9	895.8	100.1	7,663.7
Need of Liming Materials ('000 mt $CaCO_3$)								
Strongly Acid	<= 4.0	179.6	328.3	353.6	129.7	161.7	65.3	1,218.2
Very Acid	4.1 - 4.5	776.3	613.4	806.3	2,436.2	1,058.3	367.2	6,057.7
Average Acid	4.6 - 5.0	683.2	905.3	1,567.3	2,244.2	674.3	52.2	6,126.5
Weakly Acid	5.1 - 5.5	252.9	595.0	2,169.9	3,632.8	1,297.0	96.3	8,043.9
Soils close to neutral	5.6 - 6.0	35.0	336.1	1,287.5	2,669.7	1,250.6	112.8	5,691.7
Total		1,927.0	2,778.1	6,184.6	11,112.6	4,441.9	693.8	27,138.0

Source: Koslov and Dobrodiuk.

Table VI-6. Recommended Application Rates of Mineral Fertilizers Supplied to Crops, Ukraine (nutrient, kg/ha)

Crop	N-P-K	Zone, Sub-Zone					
		Forest	Forest-Steppe-Western	Forest-Steppe-Central & Left Bank	Steppe-North and Northwest	Steppe-Central and East	Steppe-South, SW, Crimea
Winter Wheat	N	80 - 100	90 - 120	60 - 100	60 - 80	60 - 80	40 - 60
	P_2O_5	60 - 80	60 - 90	50 - 80	60 - 70	40 - 60	40 - 50
	K_2O	60 - 80	60 - 90	60 - 90	40 - 60	20 - 30	—
Barley	N	60 - 90	60 - 90	45 - 60	45 - 60	45 - 60	40 - 50
	P_2O_5	45 - 60	60 - 90	30 - 45	30 - 45	30 - 45	40 - 50
	K_2O	45 - 60	60 - 90	30 - 45	30 - 45	30 - 45	—
Oats	N	45 - 60	45 - 60	40 - 50	40 - 50	30 - 40	30 - 60
	P_2O_5	30 - 50	40 - 50	30 - 40	30 - 40	30 - 40	30 - 40
	K_2O	45 - 60	50 - 60	30 - 40	30 - 40	20 - 30	—
Grain Corn	N	90 - 150	80 - 120	60 - 90	60 - 90	60 - 90	40 - 60
	P_2O_5	60 - 80	80 - 90	80 - 90	50 - 60	60	40 - 60
	K_2O	60 - 90	60 - 90	60	50 - 60	30 - 45	—
Sugar Beet	N	—	180	130	100	—	—
	P_2O_5	—	150	120	80	—	—
	K_2O	—	200	160	120	—	—
Potato	N	80 - 90	80 - 100	—	—	—	—
	P_2O_5	80 - 90	60 - 80	—	—	—	—
	K_2O	100 - 120	60 - 90	—	—	—	—

Source: Dehodiuk, E. H., "Production of Ecologically Safe Products," Kiev, 1992.

Table VI-7. Crops Requiring the Greatest Amounts of Inorganic Fertilizers, Ranked by Order of Need, Ukraine, 1997

1	Sugar Beet
2	Winter Wheat
3	Corn
4	Potatoes
5	Sunflower
6	Long-fiber Flax
7	Spring Barley
8	Winter Rye

Source: Dr. M. Koslov, personal communication, 1997.

Table VI-8. Mineral and Organic Fertilization in Ukraine, 1975 to 1996

	1975	1980	1985	1990	1993	1996
Total area sown (ha '000)	31,090.1	31,097.4	30,310.1	30,056.0	27,447.9	25,296.1
Mineral Fertilizers						
Total nutrient supply (mt '000)	3,102.3	3,400.6	4,228.4	4,241.6	2,021.3	524.7
Fertilized crop area (ha '000)	25,339.4	26,572.7	27,195.8	25,090.1	16,517.5	8,169.1
Fertilized area (percent)	82.0	85.0	90.0	83.0	60.0	32.0
Nutrient supplied to soil (kg/ha)						
- sown area	100.0	109.0	140.0	141.0	74.0	21.0
- fertilized area	122.0	128.0	155.0	169.0	122.0	64.0
Organic Fertilizers						
Total supplied (mt '000)	185,662.8	242,272.5	264,817.3	257,130.8	174,829.0	80,614.5
Fertilized area (ha '000)	5,900.3	6,539.9	6,291.1	5,384.2	3,600.3	1,824.4
Fertilized area (percent)	19.0	21.0	21.0	18.0	13.0	7.0
Tons supplied (mt/ha)						
- sown area	6.0	7.8	8.7	8.6	6.4	3.2
- fertilized area	31.5	37.0	42.1	47.8	48.6	44.2

Source: E. H. Dehodiuk, personal communication, 1997.

Table VI-9. Mineral Fertilizer Supply to All Crops Sown, by Oblast and Crimea, Ukraine, 1996 With Comparison to 1993 Total

The Crimea and Oblasts	NPK Supplied				Average Per Hectare Sown (kg)
	Total NPK	Including			
		Nitrogen (N)	Phosphorus (P_2O_5), Including Phosphorus Flour	Potassium (K_2O)	
	(nutrient, '000 centners)				(kg)
Crimea	143.5	109.6	32.3	1.6	14.0
Vinnytska	453.3	319.7	73.4	60.2	32.0
Volynska	183.9	131.9	19.1	32.9	35.0
Dnipropetrovska	339.7	247.1	85.7	6.9	21.0
Donetska	177.9	137.3	36.2	4.4	14.0
Zhytomirska	331.5	189.9	54.7	86.9	34.0
Zakarpatska	35.5	19.6	11.2	4.7	34.0
Zaporizka	167.8	120.2	45.0	2.6	12.0
Ivano-Frankivska	86.1	53.0	18.5	14.6	37.0
Kyivska	287.5	215.3	38.3	33.9	26.0
Kirovogradska	97.3	75.5	20.6	1.2	8.0
Luganska	127.3	116.8	10.4	0.1	12.0
Lvivska	233.2	136.5	48.2	48.5	42.0
Mykolayivska	67.1	59.8	7.1	0.2	6.0
Odeska	173.6	142.0	28.1	3.5	11.0
Poltavska	167.5	114.2	42.9	10.4	12.0
Rivnenska	207.9	149.3	21.8	36.8	40.0
Sumska	317.8	231.5	65.3	21.0	29.0
Ternopilska	273.6	187.3	43.2	43.1	39.0
Kharkivska	215.2	160.0	40.8	14.4	14.0
Khersonska	202.2	150.7	45.9	5.6	16.0
Khmelnitska	376.8	245.5	90.5	40.8	35.0
Cherkaska	306.3	226.6	43.4	36.3	28.0
Chernivetska	80.7	44.1	26.9	9.7	34.0
Chernigivska	193.3	140.3	26.2	26.8	16.0
Total	**5,246.5**	**3,723.7**	**975.7**	**547.1**	**21.0**
Total in 1993	**20,212.6**	**9,961.9**	**4,494.9**	**5,755.8**	**74.0**

Source: Ministry of Statistics and Ukragrokhim.

Table VI-10. Mineral Fertilizer Supply to Sugar Beet by Oblast, Ukraine, 1996 With Comparison to 1993 Total

The Crimea and Oblasts	NPK Supplied				Average Per Hectare Sown (kg)
	Total NPK	Including			
		Nitrogen (N)	Phosphorus (P_2O_5), Including Phosphorus Flour	Potassium (K_2O)	
	(nutrient, '000 centners)				(kg)
Crimea	0.1	0.1	0.0	0.0	8.0
Vinnytska	209.1	131.4	37.6	40.1	130.0
Volynska	48.1	29.3	6.8	12.0	178.0
Dnipropetrovska	27.7	14.9	11.2	1.6	87.0
Donetska	1.0	0.6	0.3	0.1	14.0
Zhytomirska	110.9	45.9	21.5	43.5	259.0
Zakarpatska	0.0	0.0	0.0	0.0	0.0
Zaporizka	2.0	1.0	0.8	0.2	32.0
Ivano-Frankivska	23.4	13.2	5.8	4.4	154.0
Kyivska	103.0	64.2	21.3	17.5	109.0
Kirovogradska	33.4	22.2	10.7	0.5	38.0
Luganska	0.5	0.3	0.2	0.0	9.0
Lvivska	76.3	37.2	19.2	19.9	210.0
Mykolayivska	5.8	4.3	1.5	0.0	20.0
Odeska	13.8	7.8	5.2	0.8	42.0
Poltavska	62.7	35.3	21.0	6.4	57.0
Rivnenska	71.9	41.5	11.5	18.9	198.0
Sumska	115.0	70.8	29.5	14.7	147.0
Ternopilska	133.1	83.1	26.3	26.4	165.0
Kharkivska	66.7	40.2	19.7	6.8	63.0
Khersonska	4.3	3.0	0.6	0.7	72.0
Khmelnitska	148.0	88.7	35.9	23.4	141.0
Cherkaska	97.3	55.0	24.4	17.9	87.0
Chernivetska	24.4	12.6	8.4	3.4	114.0
Chernigivska	47.7	27.5	10.8	9.4	132.0
Total	**1,426.2**	**830.1**	**330.2**	**268.6**	**112.0**
Total in 1993	**4,200.0**	**1,644.3**	**1,038.9**	**1,517.7**	**282.0**

Source: Ministry of Statistics and Ukragrokhim.

Table VI-11. Mineral Fertilizer Supply to Grain Corn by Oblast and the Crimea, Ukraine, 1996, With Comparison to 1993 Total

The Crimea and Oblasts	NPK Supplied				Average Per Hectare Sown (kg)
	Total NPK	Including			
		Nitrogen (N)	Phosphorus (P_2O_5), Including Phosphorus Flour	Potassium (K_2O)	
	(nutrient, '000 centners)				(kg)
Crimea	0.2	0.1	0.1	0.0	12.0
Vinnytska	13.0	8.9	3.1	1.0	29.0
Volynska	0.0	0.0	0.0	0.0	63.0
Dnipropetrovska	24.2	16.3	7.6	0.3	47.0
Donetska	1.3	0.9	0.4	0.0	14.0
Zhytomirska	0.8	0.5	0.1	0.2	112.0
Zakarpatska	4.7	2.5	1.5	0.7	87.0
Zaporizka	2.3	1.3	1.0	0.0	26.0
Ivano-Frankivska	0.5	0.3	0.1	0.1	46.0
Kyivska	8.2	6.8	0.5	0.9	55.0
Kirovogradska	2.0	0.9	1.0	0.1	15.0
Luganska	1.5	1.2	0.3	0.0	27.0
Lvivska	0.1	0.1	0.0	0.0	29.0
Mykolayivska	0.6	0.4	0.2	0.0	6.0
Odeska	6.2	3.1	2.9	0.2	17.0
Poltavska	7.5	5.2	1.8	0.5	19.0
Rivnenska	2.4	2.3	0.0	0.1	146.0
Sumska	5.2	3.9	1.0	0.3	47.0
Ternopilska	1.6	1.1	0.3	0.2	48.0
Kharkivska	5.1	3.8	1.1	0.2	31.0
Khersonska	14.0	11.2	1.8	1.0	89.0
Khmelnitska	5.4	2.7	1.6	1.1	51.0
Cherkaska	15.2	9.1	3.3	2.8	44.0
Chernivetska	4.7	2.1	1.9	0.7	46.0
Chernigivska	4.7	3.8	0.5	0.4	65.0
Total	131.4	88.5	32.1	10.8	37.0
Total in 1993	1,109.4	539.5	312.8	257.1	107.0

Source: Ministry of Statistics and Ukragrokhim.

Table VI-12. Mineral Fertilizer Supply to Winter and Spring Wheat by Oblast and the Crimea, Ukraine, 1996, With Comparison to 1993 Total

The Crimea and Oblasts	NPK Supplied				Average Per Hectare Sown (kg)
	Total NPK	Including			
		Nitrogen (N)	Phosphorus (P_2O_5), Including Phosphorus Flour	Potassium (K_2O)	
	(nutrient, '000 centners)				(kg)
Crimea	75.0	56.8	17.8	0.4	30.0
Vinnytska	129.9	107.9	14.5	7.5	50.0
Volynska	44.5	35.8	3.8	4.9	42.0
Dnipropetrovska	152.0	125.6	24.9	1.5	41.0
Donetska	91.5	80.8	10.5	0.2	32.0
Zhytomirska	89.1	62.8	11.4	14.9	56.0
Zakarpatska	10.5	7.7	1.7	1.1	53.0
Zaporizka	81.1	84.8	15.9	0.4	31.0
Ivano-Frankivska	27.8	18.9	5.5	3.4	55.0
Kyivska	93.2	77.3	9.3	6.6	41.0
Kirovogradska	47.6	43.4	4.1	0.1	16.0
Luganska	77.6	75.5	2.1	0.0	31.0
Lvivska	61.3	35.9	13.3	12.1	46.0
Mykolayivska	48.5	45.5	2.8	0.2	14.0
Odeska	117.0	109.7	6.4	0.9	27.0
Poltavska	60.7	49.3	9.9	1.5	19.0
Rivnenska	44.7	35.3	3.6	5.8	46.0
Sumska	65.1	52.0	11.8	1.3	32.0
Ternopilska	64.3	47.0	10.0	7.3	42.0
Kharkivska	79.0	70.7	7.0	1.3	23.0
Khersonska	114.2	90.7	22.7	0.8	32.0
Khmelnitska	109.2	76.3	26.0	6.9	48.0
Cherkaska	120.7	105.4	7.6	7.7	50.0
Chernivetska	23.2	14.1	7.2	1.9	54.0
Chernigivska	52.9	48.9	2.5	1.5	29.0
Total	1,880.6	1,538.1	252.3	90.2	33.0
Total in 1993	5,432.1	3,129.3	1,122.4	1,180.4	99.0

Source: Ministry of Statistics and Ukragrokhim.

Table VI-13. Mineral Fertilizer Supply to Cereals (Not Including Corn) by Oblast and the Crimea, Ukraine, 1996, With Comparison to 1993 Total

The Crimea and Oblasts	NPK Supplied				Average Per Hectare Sown (kg)
	Total NPK	Including			
		Nitrogen (N)	Phosphorus (P_2O_5), Including Phosphorus Flour	Potassium (K_2O)	
	(nutrient, '000 centners)				(kg)
Crimea	119.8	92.6	26.6	0.6	24.0
Vinnytska	167.5	133.4	23.6	10.5	27.0
Volynska	63.3	49.0	5.8	8.5	26.0
Dnipropetrovska	186.5	149.5	35.4	1.6	28.0
Donetska	119.4	102.3	16.9	0.2	23.0
Zhytomirska	118.3	80.1	18.3	19.9	29.0
Zakarpatska	16.9	9.6	5.7	1.6	48.0
Zaporizka	106.4	82.6	23.0	0.8	20.0
Ivano-Frankivska	33.8	21.6	7.4	4.8	34.0
Kyivska	107.2	88.7	10.6	7.9	23.0
Kirovogradska	50.8	45.4	5.2	0.2	9.0
Luganska	102.6	97.6	5.0	0.0	21.0
Lvivska	82.6	47.4	18.5	16.7	34.0
Mykolayivska	51.8	48.2	3.4	0.2	9.0
Odeska	132.8	119.8	12.0	1.0	19.0
Poltavska	68.7	54.1	12.8	1.8	11.0
Rivnenska	58.5	46.5	4.7	7.3	25.0
Sumska	101.2	74.9	23.3	3.0	19.0
Ternopilska	81.4	57.3	14.5	9.5	26.0
Kharkivska	88.7	76.2	10.9	1.6	14.0
Khersonska	127.0	98.9	27.3	0.8	21.0
Khmelnitska	137.9	91.8	37.0	9.1	29.0
Cherkaska	133.7	114.1	9.9	9.7	29.0
Chernivetska	30.5	17.2	10.7	2.6	37.0
Chernigivska	80.2	70.7	6.7	2.8	14.0
Total	2,367.5	1,869.5	375.3	122.7	21.0
Total in 1993	7,746.6	4,245.8	1,702.1	1,798.7	65.0

Source: Ministry of Statistics and Ukragrokhim.

Table VI-14. Grain Production in All Categories of Farms, Selected Years, Ukraine

Indices	On Average Per Year											
	1913	1940	1950	1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996
Gross Yield (grain weight after processing, '000 mt)												
Total of cereals	23,157	26,420	20,448	23,936	29,348	33,362	40,012	43,151	39,331	49,398	38,453	25,966
Among them:												
Winter wheat	3,645	7,650	5,989	10,630	11,777	16,193	19,742	21,910	18,756	24,459	18,422	13,333
Winter rye	4,540	4,097	4,334	2,107	1,657	1,225	1,308	1,278	1,181	1,282	1,095	1,091
Spring barley	5,420	5,662	2,152	3,308	3,191	5,229	7,709	10,032	7,041	9,230	9,623	5,314
Corn for grain	870	2,550	4,177	4,333	8,034	5,957	5,949	4,353	6,511	7,344	3,263	1,836
Level of Yield (grain weight after processing, centners/ha)												
Total cereals	9.4	12.4	10.2	15.2	17.5	21.4	24.7	26.1	24.3	31.8	27.5	19.6
Among them:												
Winter wheat	11.8	12.1	11.1	16.9	18.4	23.6	28.4	30.1	27.4	37.9	32.0	23.2
Winter rye	10.1	11.1	11.1	10.6	11.8	12.8	17.6	17.8	16.8	22.4	21.3	17.4
Spring barley	9.3	14.2	7.8	15.4	15.8	19.6	22.6	24.0	22.3	29.4	27.1	16.8
Corn for grain	10.2	16.3	15.2	18.0	24.0	27.6	27.7	29.0	29.8	34.6	28.4	27.4
Harvested Areas ('000 ha)												
Total of cereals	24,697	21,385	20,047	15,747	16,770	15,590	16,199	16,533	16,186	15,525	13,983	13,248
Among them:												
Winter wheat	3,088	6,317	5,382	6,290	6,400	6,861	5,951	7,279	6,845	6,407	5,757	5,747
Winter rye	4,517	3,685	3,905	1,988	1,404	957	743	718	703	571	514	627
Spring barley	5,824	3,986	2,744	2,278	1,966	2,088	3,413	4,103	3,171	3,186	3,551	3,163
Corn for grain	853	1,561	2,757	2,407	3,347	2,158	2,148	1,501	2,165	2,124	1,149	670

Source: Agrarian Institute of JSC "Agroincom" on the basis of Ministry of Statistics materials.

Table VI-15. Sown Areas, Gross Yield, and Yield per Hectare of Winter Cereals by Categories of Farm and Major Crop Zone, 1996, Ukraine

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
			Among Them			
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms	Private Household Plots and Those of Lease-Holders	Private Farms
Sown Areas of Agricultural Crops ('000 ha)						
All crops						
- Ukraine[a]	30,060.7	25,988.6	22,955.3	3,033.6	3,551.4	520.7
- Forest zone	5,368.5	4,239.7	3,932.0	276.4	1,074.7	52.7
- Forest-steppe zone	11,414.3	9,826.9	8,648.8	1,177.6	1,451.4	135.8
- Steppe zone	13,277.3	11,921.0	10,373.1	1,547.1	1,025.4	329.9
Winter cereals						
- Ukraine	6,636.4	6,257.6	5,524.4	733.2	253.8	125.1
- Forest zone	1,222.1	1,078.4	1,001.9	76.4	127.0	16.4
- Forest-steppe zone	2,266.2	2,146.2	1,896.6	249.4	88.9	31.3
- Steppe zone	3,147.9	3,033.0	2,625.9	407.0	37.7	77.0
Gross Yield ('000 mt)						
Winter cereals						
- Ukraine[a]	14,835.4	14,049.1	12,465.0	1,584.1	612.2	174.1
- Forest zone	2,640.8	2,298.9	2,080.5	137.9	306.7	29.6
- Forest-steppe zone	6,323.1	6,034.8	5,345.1	689.7	233.1	55.2
- Steppe zone	6,076.2	5,917.4	5,203.1	715.0	68.8	88.8
Yield Level (centners/ha)						
Winter cereals						
- Ukraine	22.4	22.5	22.6	21.6	24.1	13.9
- Forest zone	21.6	21.3	20.8	18.1	24.2	18.0
- Forest-steppe zone	27.9	28.1	28.2	27.7	26.2	17.6
- Steppe zone	19.3	19.5	19.8	17.6	18.3	11.5

a. Ukraine total does not equal sum of zones in original data set.

Source: Ministry of Statistics.

Table VI-16. Harvested Areas, Gross Yield, and Levels of Yield of Winter Cereals in All Categories of Farms of Crimea and the Oblasts by Soil-Climatic Zone, Ukraine, 1996

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Among Them		Private Household Plots and Those of Lease-Holders	Private Farms
			Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms		
	Harvested Area ('000 ha)					
Ukraine	**6,636.4**	**6,257.6**	**5,524.4**	**733.2**	**253.8**	**125.1**
Forest	**1,222.1**	**1,078.4**	**1,001.9**	**76.4**	**127.0**	**16.4**
Volynska	204.8	175.2	164.2	11.0	26.7	2.8
Zhytomyrska	264.8	235.2	219.7	15.6	28.4	1.1
Zakarpatska	32.8	27.5	22.6	4.8	3.6	1.8
Ivano-Frankivska	59.4	51.6	47.9	3.6	6.8	1.1
Lvivska	173.1	147.2	136.6	10.6	21.7	4.1
Rivnenska	171.5	150.8	142.6	8.2	19.2	1.4
Chernihivska	315.7	290.9	268.3	22.6	20.6	4.1
Forest-Steppe	**2,266.2**	**2,146.2**	**1,896.6**	**249.4**	**88.9**	**31.3**
Vinnytska	276.3	270.2	250.2	20.0	3.8	2.4
Kyivska	286.5	257.5	208.6	48.9	24.8	4.3
Poltavska	360.9	337.5	300.9	36.6	17.4	6.0
Sumska	243.6	231.9	209.5	22.3	6.6	5.1
Ternopilska	169.1	156.6	146.0	10.6	9.9	2.6
Kharkivska	367.4	356.7	284.3	72.4	4.5	6.3
Khmelnytska	247.6	239.5	224.2	15.2	6.1	2.0
Cherkaska	266.9	250.3	230.3	20.1	14.2	2.3
Chernivetska	47.9	46.0	42.6	3.3	1.6	0.3
Steppe	**3,147.9**	**3,033.0**	**2,625.9**	**407.0**	**37.7**	**77.0**
Crimea	336.6	325.5	224.2	101.3	7.6	3.4
Dnipropetrovska	391.1	379.8	340.3	39.5	3.2	8.1
Donetska	305.2	297.5	259.9	37.6	2.3	5.4
Zaporizka	226.9	218.3	168.6	49.7	4.9	3.6
Kirovohradska	332.4	316.2	297.7	18.4	4.9	11.3
Luhanska	279.6	269.4	247.3	22.1	1.5	8.7
Mykolayivska	406.7	392.4	327.1	65.3	0.5	13.7
Odeska	522.9	507.1	470.6	36.4	3.8	12.1
Khersonska	346.5	326.8	290.2	36.7	9.0	10.7

(Continued)

Table VI-16. Harvested Areas, Gross Yield, and Levels of Yield of Winter Cereals in All Categories of Farms of Crimea and the Oblasts by Soil-Climatic Zone, Ukraine, 1996 (Continued)

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Among Them		Private Household Plots and Those of Lease-Holders	Private Farms
			Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms		
	Gross Yield (centners '000)					
Ukraine	**148,353.8**	**140,491.1**	**124,650.2**	**15,841.0**	**6,122.0**	**1,740.6**
Forest	**26,408.3**	**22,989.2**	**20,804.6**	**1,379.1**	**3,067.2**	**295.9**
Volynska	3,621.0	2,966.3	2,767.9	198.3	608.0	46.7
Zhytomyrska	5,017.9	4,323.1	4,068.7	254.4	680.8	14.0
Zakarpatska	4,287.9	4,157.1	3,225.0	126.6	116.2	58.5
Ivano-Frankivska	961.4	805.8	755.2	50.6	141.1	14.5
Lvivska	3,615.8	2,859.9	2,683.0	177.0	577.2	78.7
Rivnenska	3,246.6	2,764.3	2,612.6	151.6	459.5	22.9
Chernihivska	5,657.7	5,112.7	4,692.2	420.6	484.4	60.6
Forest-Steppe	**63,231.1**	**60,347.9**	**53,451.3**	**6,896.7**	**2,330.6**	**552.4**
Vinnytska	7,969.2	7,846.0	7,340.9	505.2	75.5	47.8
Kyivska	8,757.4	7,968.5	6,552.2	1,416.3	700.9	87.8
Poltavska	10,654.7	10,065.4	8,906.6	1,158.7	479.0	110.2
Sumska	4,909.5	4,698.8	4,196.2	502.5	141.8	69.0
Ternopilska	4,253.2	3,990.1	3,750.6	239.6	219.1	43.9
Kharkivska	10,206.1	9,974.2	7,942.5	2,031.8	122.3	109.6
Khmelnytska	6,526.4	6,382.2	6,064.1	318.1	107.7	36.5
Cherkaska	9,043.6	8,551.2	7,889.8	661.4	449.9	42.5
Chernivetska	911.0	871.5	808.4	63.1	34.4	5.1
Steppe	**60,762.4**	**59,174.2**	**52,030.9**	**7,149.6**	**688.4**	**888.0**
Crimea	4,198.1	4,060.4	2,861.1	1,205.5	88.5	37.5
Dnipropetrovska	9,074.7	8,887.9	7,904.6	983.3	80.1	106.7
Donetska	7,567.7	7,428.6	6,467.8	960.9	54.2	84.8
Zaporizka	4,287.9	4,157.1	3,225.0	932.1	91.3	39.7
Kirovohradska	7,798.5	7,551.1	7,223.5	327.6	91.3	156.0
Luhanska	5,322.8	5,185.9	4,770.2	415.7	29.7	107.2
Mykolayivska	7,099.4	6,957.5	5,886.6	1,070.8	6.8	135.1
Odeska	9,581.6	9,387.7	8,711.0	676.8	70.5	123.3
Khersonska	5,831.7	5,558.0	4,981.1	576.9	176.0	97.7

(Continued)

Table VI-16. Harvested Areas, Gross Yield, and Levels of Yield of Winter Cereals in All Categories of Farms of Crimea and the Oblasts by Soil-Climatic Zone, Ukraine, 1996 (Continued)

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Among Them		Private Household Plots and Those of Lease-Holders	Private Farms
			Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms		
	Level of Yield (centners/ha)					
Ukraine	**22.4**	**22.5**	**22.6**	**21.6**	**24.1**	**13.9**
Forest	**21.6**	**21.3**	**20.8**	**18.1**	**24.2**	**18.0**
Volynska	17.7	16.9	16.9	18	22.7	16.3
Zhytomyrska	18.9	18.4	18.5	16.3	24.0	12.3
Zakarpatska	28.7	28.1	28.4	26.4	32.3	31.7
Ivano-Frankivska	16.2	15.6	15.6	13.8	20.9	13.2
Lvivska	20.3	19.4	19.6	16.6	26.6	18.8
Rivnenska	18.9	18.3	18.3	18.5	23.9	15.9
Chernihivska	17.9	17.6	17.5	18.6	23.6	14.6
Forest-Steppe	**27.9**	**28.1**	**28.2**	**27.7**	**26.2**	**17.6**
Vinnytska	28.8	29.0	29.3	25.2	19.9	20.3
Kyivska	30.6	31.0	31.4	29.0	28.3	20.4
Poltavska	29.5	29.8	29.6	31.7	27.4	18.3
Sumska	20.1	20.3	20.0	22.4	21.3	13.4
Ternopilska	25.2	25.5	25.7	22.6	22.0	17.2
Kharkivska	27.8	28.0	27.9	28.1	27.5	17.5
Khmelnytska	26.4	26.6	27.0	20.8	17.7	18.9
Cherkaska	33.9	34.2	34.3	33.0	31.6	18.3
Chernivetska	19.0	19.0	19.0	19.0	21.3	13.9
Steppe	**19.3**	**19.5**	**19.8**	**17.6**	**18.3**	**11.5**
Crimea	16.6	16.7	17.0	16.0	16.3	12.3
Dnipropetrovska	23.2	23.4	23.2	24.9	24.2	13.2
Donetska	24.8	25.0	24.9	25.6	24.0	15.5
Zaporizka	18.9	19.0	19.1	18.7	18.6	11.1
Kirovohradska	23.5	23.9	24.3	17.7	18.4	13.9
Luhanska	19.0	19.2	19.3	18.8	20.4	12.3
Mykolayivska	17.5	17.7	18.0	16.4	15.1	9.8
Odeska	18.3	18.5	18.5	18.6	18.9	10.2
Khersonska	16.8	17.0	17.2	15.7	19.6	9.2

Source: Ministry of Statistics.

Table VI-17. Harvested Areas, Gross Yield, and Levels of Yield of Winter Rye in All Categories of Farms of Crimea and the Oblasts by Soil-Climatic Zone, Ukraine, 1996

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Among Them		Private Household Plots and Those of Lease-Holders	Private Farms
			Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms		
	Harvested Area ('000 ha)					
Ukraine	**627.1**	**580.4**	**527.5**	**52.9**	**36.6**	**10.1**
Forest	**390.5**	**355.1**	**331.0**	**24.1**	**29.7**	**5.7**
Volynska	82.4	72.3	69.0	3.3	8.6	1.4
Zhytomyrska	87.9	80.5	73.8	6.8	6.9	0.5
Zakarpatska	2.1	2.0	1.5	0.5	0.1	0.0
Ivano-Frankivska	6.9	4.8	4.4	0.4	1.9	0.2
Lvivska	23.2	20.4	18.5	1.9	2.2	0.6
Rivnenska	60.2	54.5	51.5	2.9	5.3	0.5
Chernihivska	127.8	120.6	112.3	8.3	4.7	2.5
Forest-Steppe	**147.3**	**138.3**	**118.9**	**19.4**	**6.5**	**2.5**
Vinnytska	11.4	10.9	9.6	1.4	0.4	0.1
Kyivska	33.9	30.8	24.8	6.0	2.7	0.4
Poltavska	19.6	18.5	16.7	1.8	0.7	0.4
Sumska	38.5	37.3	33.8	3.4	0.3	0.9
Ternopilska	7.3	6.4	5.7	0.7	0.7	0.2
Kharkivska	14.6	14.3	10.4	3.9	0.1	0.3
Khmelnytska	11.6	10.8	9.5	1.3	0.7	0.1
Cherkaska	9.3	8.3	7.5	0.9	0.8	0.1
Chernivetska	1.1	1.0	0.9	0.0	0.1	0.0
Steppe	**89.3**	**87.0**	**77.7**	**9.3**	**0.3**	**1.8**
Crimea	4.0	4.0	2.6	1.4	0.0	0.0
Dnipropetrovska	11.0	10.7	9.7	1.0	0.0	0.3
Donetska	8.0	8.0	6.9	1.1	0.0	0.0
Zaporizka	5.6	5.5	4.6	0.9	0.0	0.0
Kirovohradska	16.9	16.1	15.4	0.7	0.1	0.7
Luhanska	17.9	17.2	16.3	0.9	0.2	0.5
Mykolayivska	9.4	9.3	7.8	1.5	0.0	0.0
Odeska	9.9	9.6	8.8	0.8	0.0	0.3
Khersonska	6.6	6.6	5.6	1.0	0.0	0.0

(Continued)

Table VI-17. Harvested Areas, Gross Yield, and Levels of Yield of Winter Rye in All Categories of Farms of Crimea and the Oblasts by Soil-Climatic Zone, Ukraine, 1996
(Continued)

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Among Them		Private Household Plots and Those of Lease-Holders	Private Farms
			Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms		
	Gross Yield (centners '000)					
Ukraine	**10,924.4**	**9,949.2**	**9,017.7**	**931.5**	**839.5**	**135.9**
Forest	**5,945.0**	**5,202.7**	**4,956.0**	**346.7**	**661.8**	**80.7**
Volynska	1,146.6	958.8	910.4	48.4	168.1	19.7
Zhytomyrska	1,184.9	1,002.4	927.9	74.5	177.6	4.9
Zakarpatska	52.5	50.3	39.2	11.0	2.0	0.3
Ivano-Frankivska	99.2	62.5	57.6	4.9	34.4	2.3
Lvivska	364.9	309.5	284.6	24.9	45.2	10.2
Rivnenska	951.0	831.8	886.4	45.4	112.5	6.8
Chernihivska	2,145.9	1,987.4	1,849.9	137.6	122.0	36.5
Forest-Steppe	**3,147.4**	**2,944.1**	**2,532.9**	**411.3**	**168.7**	**34.3**
Vinnytska	249.3	238.0	216.3	21.8	10.0	1.2
Kyivska	579.2	496.7	391.2	105.5	77.5	4.9
Poltavska	549.1	523.3	470.9	52.4	19.9	5.9
Sumska	706.4	686.7	617.5	69.2	6.3	13.4
Ternopilska	142.1	124.2	113.1	11.1	14.9	2.9
Kharkivska	409.3	404.0	289.9	114.1	1.8	3.5
Khmelnytska	232.9	219.7	199.8	19.9	12.4	0.8
Cherkaska	259.1	233.3	217.0	16.3	24.1	1.7
Chernivetska	20.0	18.2	17.2	1.0	1.8	0.0
Steppe	**1,832.1**	**1,802.3**	**1,628.6**	**173.7**	**8.7**	**20.9**
Crimea	62.8	62.7	42.4	20.3	0.1	0.0
Dnipropetrovska	264.5	259.8	237.5	22.3	1.2	3.5
Donetska	201.2	200.3	173.3	27.0	0.0	0.8
Zaporizka	123.8	123.4	102.5	20.9	0.5	0.0
Kirovohradska	345.5	333.1	319.5	13.6	3.2	9.1
Luhanska	353.4	345.3	327.6	17.7	3.7	4.4
Mykolayivska	167.2	167.1	145.4	21.7	0.0	0.1
Odeska	189.7	186.8	171.6	15.2	0.0	2.9
Khersonska	124.0	123.8	108.8	15.0	0.0	0.1

(Continued)

Table VI-17. Harvested Areas, Gross Yield, and Levels of Yield of Winter Rye in All Categories of Farms of Crimea and the Oblasts by Soil-Climatic Zone, Ukraine, 1996
(Continued)

Ukraine, Zones and Oblasts (Plus Crimea)	All Categories of Farms	Including				
		Collective, Inter-Farm Agricultural Enterprises, State Farms, and Other Public and Co-Op Farms	Among Them		Private Household Plots and Those of Lease-Holders	Private Farms
			Collective, Inter-Farm Agricultural Enterprises, and Co-Op Farms	State Farms and Other Public Farms		
	Level of Yield (centners/ha)					
Ukraine	**17.4**	**17.1**	**17.1**	**17.6**	**23.0**	**13.5**
Forest	**15.2**	**14.7**	**15.0**	**14.4**	**22.3**	**14.2**
Volynska	13.9	13.3	13.2	14.6	19.5	13.8
Zhytomyrska	13.5	12.4	12.6	11.0	25.8	10.0
Zakarpatska	25.4	25.8	26.5	23.6	19.0	16.5
Ivano-Frankivska	14.3	12.9	13.1	11.2	18.2	12.6
Lvivska	15.7	15.2	15.4	12.8	20.8	15.8
Rivnenska	15.8	15.3	15.3	15.7	21.3	12.9
Chernihivska	16.8	16.5	16.5	16.7	26.2	14.4
Forest-Steppe	**21.4**	**21.3**	**21.3**	**21.2**	**26.0**	**13.7**
Vinnytska	21.8	21.8	22.6	15.9	24.3	12.3
Kyivska	17.1	16.1	15.8	17.6	29.0	11.8
Poltavska	28.0	28.3	28.2	29.0	28.2	14.0
Sumska	18.3	18.4	18.2	20.1	18.2	14.8
Ternopilska	19.5	19.5	20.0	15.5	20.8	15.5
Kharkivska	28.0	28.3	27.9	29.3	29.0	13.4
Khmelnytska	20.0	20.3	21.0	14.9	17.2	15.7
Cherkaska	27.9	28.0	29.1	18.6	24.1	14.6
Chernivetska	18.7	19.0	18.8	22.6	18.3	2.2
Steppe	**20.5**	**20.7**	**21.0**	**18.7**	**29.0**	**11.6**
Crimea	15.9	15.9	16.5	14.8	17.3	0.0
Dnipropetrovska	24.0	24.3	24.4	23.0	25.3	11.8
Donetska	25.2	25.2	25.1	25.5	27.0	17.8
Zaporizka	22.3	22.3	22.3	22.2	22.3	17.0
Kirovohradska	20.4	20.7	20.8	18.5	23.8	13.9
Luhanska	19.9	20.1	20.1	20.0	20.1	8.7
Mykolayivska	17.9	17.9	18.6	14.2	0.0	4.6
Odeska	19.2	19.4	19.5	18.2	24.0	11.4
Khersonska	18.7	18.7	19.4	14.9	0.0	7.4

Source: Ministry of Statistics.

Table VI-18. Sugar Beet and Sugar Production in All Categories of Farms, Selected Years, Ukraine

Indices	On Average Per Year											
	1913	1940	1950	1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996
Area ('000 ha)	558	820	828	1,457	1,724	1,757	1,717	1,791	1,698	1,645	1,498	1,258
Productivity of crops (centners/ha)	167	159	177	218	199	267	268	300	258	266	209	181
Gross yield ('000 mt)	9,337	13,052	14,624	31,761	34,130	46,731	45,957	53,891	43,871	43,757	31,318	22,812
"Sugariness"	-	17	18	17	18	17	17	16	16	16	16	16
Sugar output (%)	13	13	14	12	14	13	12	11	12	11	12	12
Sugar production from harvest ('000 mt)	1,108	1,629	1,963	3,446	4,281	5,325	4,790	4,560	4,451	4,988	3,568	2,715

Source: Agrarian Institute of JSC "Agroincom" on the basis of Ministry of Statistics materials.

Table VI-19. Comparison of Sown Areas and Mineral Fertilizers Supplied to Farms in Ukraine, 1991 and 1996

Item	Area			Fertilizer Applied			Fertilizer Applied per ha Sown		
	1991	1996	% change	1991	1996	% change	1991	1996	% change
	('000 ha)			('000 mt)			(kg)		
Total sown area	30,016.0	25,296.1	(15.7)	4,238.0	524.7	(87.6)	141.2	20.7	(85.3)
Total fertilized area	22,090.0	8,169.1	(63.0)	4,238.0	524.7	(87.6)	191.9	64.2	(66.5)
Fertilized area, % of total sown	73.0	32.0	x	x	x	x	x	x	x
Selected crops									
Cereals, including corn	12,635.2	10,770.6	(14.8)	2,097.0	240.2	(88.5)	166.0	21.0	(87.3)
- Winter and spring wheat	5,161.4	5,360.3	3.9	671.0	188.1	(72.0)	130.0	35.0	(73.1)
- Winter rye	564.1	5,452.0	866.5	73.0	15.0	(79.5)	129.0	27.5	(78.7)
- Spring and winter barley	3,894.6	2,713.6	(30.3)	467.0	24.0	(94.9)	120.0	9.0	(92.5)
- Corn for grain	836.3	468.1	(44.0)	201.0	13.1	(93.5)	240.0	27.0	(88.8)
Total technical crops	3,611.0	3,652.0	1.1	1,242.0	157.6	(87.3)	344.0	43.0	(87.5)
- Sugar beet	1,558.0	135.9	(91.3)	640.0	142.6	(77.7)	411.0	164.9	(59.9)
- Sunflower	1,601.0	2,107.0	31.6	173.0	12.5	(92.8)	108.0	6.0	(94.4)
- Long-fiber flax	159.0	65.0	(59.1)	35.0	2.5	(92.9)	220.0	38.0	(82.7)
Potatoes	1,533.0	1,547.0	0.9	325.0	5.1	(98.4)	212.0	3.3	(98.4)
Vegetables	477.0	476.0	(0.2)	69.0	7.7	(88.8)	144.0	16.3	(88.7)
Other crops	12,397.0	11,692.0	(5.7)	505.0	114.1	(77.4)	41.0	9.7	(76.3)

Source: Department of Mineral Fertilizers (Minprom, Ukraine).

Table VI-20. Delivery of Mineral Fertilizers to Agricultural Sector of Ukraine as of January 1, 1997 ('000 mt nutrient)

Oblast	Nitrogen	Phosphorus	Potassium	Total
Crimea	16.7	0.1	0.0	16.8
Vinnitska	14.0	5.3	1.5	20.8
Volynska	6.7	3.0	1.5	11.2
Dnepropetrovska	49.6	5.6	0.6	55.8
Donetska	13.1	4.7	0.4	18.2
Zhytomirska	11.6	5.2	2.4	19.2
Zakarpatska	2.5	0.6	0.3	3.4
Zaporizka	7.3	4.1	0.4	11.8
Ivano-Frankivska	4.5	2.5	2.7	9.7
Kyivska	17.2	3.6	2.0	22.8
Kirovogradska	6.2	2.5	0.0	8.7
Luganska	11.6	1.9	0.0	13.5
Lvivska	14.7	6.7	5.6	27.0
Mykolayivska	5.2	1.1	0.0	6.3
Odeska	9.2	2.0	0.3	11.5
Poltavska	9.0	3.8	1.3	14.1
Rivnenska	9.2	2.0	3.3	14.5
Sumska	12.4	9.0	0.7	22.1
Ternopilska	8.3	3.5	3.0	14.8
Kharkivska	9.4	6.3	1.9	17.6
Khersonska	11.5	6.5	0.1	18.1
Khmelnitska	14.7	7.0	2.3	24.0
Cherkaska	17.4	4.8	2.7	24.9
Chernivetska	2.9	1.9	0.9	5.7
Chernigivska	10.1	2.6	3.1	15.8
Others	5.5	0.0	0.0	5.5
Total	300.5	96.3	37.0	433.8

Table VI-21. General Information on Production and Use of Organic Fertilizers in Ukrainian Agriculture

Of the past 30 years (1966-95), the largest quantity of organic fertilizers was applied in 1986-90 — more than 266 million mtpy, or 8.7 mt/ha. To maintain humus levels in soil, it is necessary to supply 340 million mt annually; to enhance, it requires 400-450 million mt.

The existing number of cattle (as of August 1, 1996) can provide approximately 120 million mt of manure per year, i.e., 35% of the minimum need.

Estimated Manure Output by Livestock and Poultry in Ukraine, 1990 and 1996

Livestock Type	Number of livestock (millions)			Manure output rate (mt/year)	Total amount of manure (million mt)
	1990	August 1, 1996	Reduction (percent)		
Total cattle	21.1	12.6	60.0	—	103.4
- Cows	—	4.6	—	12.00	55.2
- Young animals	—	8.0	—	6.00	48.2
Pigs	14.1	6.4	45.7	1.50	9.7
Horses	0.7	0.5	67.0	6.00	2.8
Sheep	7.2	2.0	27.0	0.90	1.8
Poultry	133.0	49.4	37.0	0.04	2.0
Total					**119.7**