Mineral Fertilizer Distribution and the Environment

International Fertilizer Industry Association
United Nations Environment Programme

International Fertilizer Industry Association

UNEP

Mineral Fertilizer Distribution and the Environment

International Fertilizer Industry Association
United Nations Environment Programme

INTERNATIONAL FERTILIZER
INDUSTRY ASSOCIATION

28, RUE MARBEUF
75008 PARIS - FRANCE

TEL: +33 153 930 500
FAX: +33 153 930 545/ 546/ 547
E-mail: ifa@fertilizer.org
URL: http:www.fertilizer.org

UNITED NATIONS ENVIRONMENT PROGRAMME

DIVISION OF TECHNOLOGY, INDUSTRY
AND ECONOMICS

39-43, QUAI ANDRE CITROËN
75739 PARIS CEDEX 15 - FRANCE

TEL: +33 144 371 450
FAX: +33 144 371 474
E-mail: unep.tie@unep.fr
URL: http:www.uneptie.org

Mineral Fertilizer Distribution and the Environment
by K.F. Isherwood
International Fertilizer Industry Association
Paris, March 2000.

ISBN: 2-9506299-4-6

The text of the document is available on IFA's Internet site.

Further copies can be obtained from:
IFA
28, rue Marbeuf
75008 Paris, France
Tel: +33 153 930 500
Fax: +33 153 930 545 /546 /547
E-mail: publications@fertilizer.org
URL: http:www.fertilizer.org

Printed in France.
Layout: Claudine Aholou-Pütz, IFA
Graphics: Hélène Ginet, IFA

Contents

PART 1. THE ISSUES

Preface

This publication is the third in the IFA/UNEP series of Mineral Fertilizers and the Environment. The first concerned Fertilizer Production and the Environment (1998), the second Fertilizer Use and the Environment (1998) and this publication completes the chain from factory to farm by dealing with the distribution sector.

The relevance of fertilizer production to the environment, with the potential for harmful emissions, and that of fertilizer use and the environment, with the potential for nutrient losses to the environment, are clear. The relevance is not so evident in the distribution sector, but it just as important.

Not only is the potential environmental impact of fertilizer distribution often under-estimated, but so too is its economic impact. Under favourable circumstances the cost of distributing and marketing fertilizers amounts to a third of the production cost. Under unfavourable circumstances it can amount to three times the production (or import) cost. Not only is the cost substantial, it is also a cost which can be influenced. In the case of a modern, well-run, large-scale fertilizer plant the possibilities of further cost savings are minimal, whereas increased efficiency in the distribution and marketing sector is often still possible.

The potential negative environmental impact of certain aspects of mineral fertilizer distribution are evident, for example accidents in storage facilities, spillage, misuse of the products and losses of nutrients to the environment during transport and storage. The distribution system can also have positive impact; if the farmer is to have the fertilizer at the time and in the form he requires it for optimum use, an efficient fertilizer distribution system is essential.

In *Soil Degradation: a Threat to Developing Country Food Security by 2020* (International Food Policy Research Institute, IFPRI, 2020 Brief 58, February 1999) S.J. Scherr writes, *Policies for high-quality rain-fed lands include better integrating technology development and extension for productivity growth on the one hand with good soil husbandry, agricultural machinery use, and agrochemical management on the other;* ***developing market-based mechanisms to improve distribution systems for fertilizers that reduce cost and improve nutrient balance;*** *and encouraging complementary use of organic nutrients.*

The consumer protection aspects should not be overlooked. Mineral fertilizers are products which can easily be adulterated and the farmer is normally unable to check the quality. The quality and labeling of mineral fertilizers is carefully regulated in the developed countries and the regulations are enforced. In developing countries, even where regulations exist, they are rarely enforced adequately, due to lack of will and/or means. The result is inefficient, wasteful and environmentally harmful use.

Norman Borlaug, the Nobel prize-winner, speaking to the Fertilizer Society of South Africa in April 1997, after emphasizing the essential rôle of modern agricultural production not only

in providing sustenance to the world but also for social stability, recommended that (the fertilizer industry) should:

- *police its own members and advise lawmakers on appropriate legislation to help avoid product adulteration and price gouging, which affects farmers, and to ensure that fertilizer is produced and used in environmentally responsible ways,*
- *strive to ensure that efficient and effective input delivery systems are developed to serve small-scale African farmers,*
- *be much more aggressive in conducting the necessary research (economic, social, political) to advise policy makers (national and international) on the best policies to develop efficient fertilizer supply systems and application practices by farmers.*

The investment and operating costs of an efficient fertilizer distribution system are higher than might be thought. The fertilizer distributor requires a margin which is sufficient to enable him to finance these costs. Furthermore, the fertilizer retailer is in direct contact with his farmer-customer. He is the best placed to give advice on the efficient use of the products he sells - if he knows what advice to give i.e. training is essential. In most developing countries the margin thought appropriate for a retailer is totally inadequate.

In developed countries fertilizers have been on the market for 150 years, whereas in developing countries fertilizer use started to increase only in the 1960s. Today their consumption has overtaken that of developed countries but their distribution systems have not kept pace, with resultant waste and inefficiencies.

In developed countries, the distribution sector is increasingly regulated for environmental compliance. The situation in the United States is an example.

The purpose of this publication is to demonstrate these aspects of fertilizer distribution and to describe its complexities, in the hope that the relevant authorities, with the fertilizer industry playing its full role as steward of its products, and all others concerned, will pay more attention to this crucial link in the development of a globally sustainable agriculture.

1. Global environmental context

1.1 Environmental Agenda

The environmental agenda now has important policy and regulatory functions in international society and many countries. Agenda 21, adopted by United Nations Conference on Environment and Development, focused world attention on the close links between the environment and socioeconomic development. It not only identifies the environmental issues that should be addressed globally, but also lists the fundamental elements to ensure the implementation of Agenda 21.

Policy leadership is given by various international bodies, such as the United Nations Commission for Sustainable Development (UNCSD), the United Nations Environment Programme (UNEP), or by regional organizations such as the Organization for Economic Cooperation and Development (OECD) and the European Commission. Some environmental issues may be subject to international agreement and conventions, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Montreal Protocol on Substances that Deplete the Ozone Layer. The international environmental agenda often influences national government decisions. It may provide operational guidelines, such as guidelines on transportation of dangerous goods, or encourage institutions to change operating practices. For example, banks and other institutions responsible for setting financial conditions are becoming more environmentally conscious.

Environmental issues in Agenda 21

- Protecting the atmosphere
- Managing land sustainability
- Combating deforestation
- Combating desertification and drought
- Sustainable agriculture and rural development
- Conservation of biological diversity
- Management of biotechnology
- Protecting and managing the oceans
- Protecting and managing fresh water
- Safer use of toxic chemicals
- Managing hazardous wastes
- Managing solid wastes and sewage
- Managing radioactive wastes

Some implementation issues in Agenda 21

- Capacity building
- Strengthening the role of business and industry
- Promoting education, public awareness and training
- Integrated decision-making
- International law
- National and international institutional arrangement
- Financial resources and mechanisms
- Information
- Science for sustainable development
- Local authorities' initiative in support of Agenda 21

Examples of global conventions concerning environment

- Convention on Biological Diversity
- Convention on International Trade in Endangered Species of Wild Fauna and Flora
- Convention on the Conservation of Migratory Species of Wild Animals
- Vienna Convention for the Protection of the Ozone Layer
- United Nations Framework Convention on Climate Change
- United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa
- Convention on Wetlands of International Importance especially as Waterfowl Habitat
- Convention Concerning the Protection of the World Cultural and Natural Heritage
- United Nations Convention on the Law of Sea

1.2 Cause for action

Action concerning environmental protection is driven by understanding of the seriousness of the problems globally. United Nations Environment Programme (UNEP) monitors and reports regularly on the state of global environment. These reports serve as constant warning to international communities, country governments, public, as well as industry, on the degradation of environment caused by human activities. These reports also call for action by all stakeholders to protect the environment for the wellbeing of human for many generations to come.

Environmental degradation is of global concern as it not only affects people's health and living environment, but also damages a country's prospects for economic and social growth. For example, agri-food production activities, in which the fertilizer industry plays an important role, have the capacity of damaging the natural resources on which they rely (e.g. water, soil, ecological system). Damaging the natural resource base affects production levels, which in turn alters overall world food supply. This can lead to potential economic and social crises.

Public awareness and concern for environmental degradation have increased significantly and globally since 1992 when the Rio Declaration on Sustainable Development came into being. The global community is now much more aware and supportive of actions by government and often becomes involved in direct actions with companies at local level. Numerous efforts are now made to look for solutions to environmental problems that human encounter in the course of economic and social development.

Some facts about the state of environment as reported by the Global Environment Outlook 2000

- Global emissions of CO_2 reached a new high of nearly 23,900 million tonnes in 1996 -more than in 1995 and nearly four times the 1950 total.
- Human activities now contribute more to the global supply of fixed nitrogen than do natural processes
- Losses from natural disasters over the decade 1986-96 were eight times higher than in the 1960s.
- The countries projected to suffer from serious shortfalls in food supply are also those faced with rapid growing population and urbanization, low productivity agriculture, high debt and insufficient wealth to import food.
- In 1995, 25 per cent of the world's approximately 4,630 mammal species and 11 percent of the 9,675 bird species were at significant risk of total extinction.
- If present consumption patterns continue, two out of every three persons on Earth will live in water-stressed condition by the year 2025.

1.3 Trends in looking for solutions

Increasingly, environmental protection programmes focus on addressing the sources/ causes of the problem. For example, the preventive approach has been recognized as an effective and preferred strategy in many parts of the world. Cleaner Production, introduced by UNEP in 1989, represents the shift from end-of-pipe approach to pollution prevention.

Environmental programmes in government and industry are also becoming more integrated and address a range of issues simultaneously, such as resource management, environmental management of industrial estates, industry ecology, etc.

The interconnected nature of environmental problems has led to a life-cycle approach. This entails looking at all steps in the production chain, as well as the product itself, e,g. from design to disposal. The objective is to see when the main environmental impacts arise and where along the chain the most cost-effective action can be taken to mitigate the impacts.

Cleaner Production is the continuous application of an integrated preventive environmental strategy applied to processes, products and service to increase eco-efficiency and reduce risks for humans and the environment. It applies to:

- production processes: conserving raw materials and energy, eliminating toxic raw materials and reducing the quantity and toxicity of all emissions and wastes,
- products: reducing negative impacts along the life cycle of a product: from raw materials extraction to its ultimate disposal,
- service: incorporating environmental concerns into designing and delivering services.

1.4 Actions by various stakeholders

Governments are looking at the integrated management of environmental issues. Discussions at the European Commission concerning the integration of industry pollution management are leading to a product-oriented environmental policy framework. While some current regulations are targeted at a specific part of a product, for instance, fertilizer composition, the environmental impacts of raw material production and the transport of end products and its distribution may be considered by a product-oriented regulatory framework.

The life-cycle approach also calls for preventive action by industry itself through systematic management of issues. In addition to environmental management systems, company environmental reporting, environmental health and safety systems, new industry environmental management initiatives such as extended producer responsibility, supply chain management, are good examples of an integrated life cycle approach.

While efforts are made increasingly by individual companies to improve their environmental performance, it has also been understood that some problems can only be addressed by collective action by an entire industry sector. More and more, collective initiatives by various industries are taking shape, such as environmental codes in the minerals industry and the environmental statements by the financing and insurance sectors respectively. Some of the industry initiatives are going beyond the traditional sector boundaries to combine efforts of all sectors within an area of economic activity. For example, within the area of agri-food production, an International Agri-food Network called IAFN has been formed. This network is composed of international associations from the seeds breeding, farming, fertilizer, crop protection, food processing, machinery, dairy, etc.

The increased environmental awareness has also led to significant joint efforts among stakeholders including governments, industries, NGOs and communities.

1.5 Fertilizer distribution, an important part of the product life cycle

The above discussion presents the global context in which this documents is developed. Having published several technical documents, e.g. "Fertilizer Industry and the Environment", "The Fertilizer Industry, World Food Supplies and the Environment", "Mineral Fertilizer Use and the Environment", IFA and UNEP have extended their joint effort to addressing the environmental issues associated with fertilizer distribution.

This report focuses on the process of transport, storage and handling of different fertilizer products, the factors that influencing the fertilizer distribution systems and the current environmental and safety measures in practices. It attempts to go beyond the production process to help the fertilizer industry understand and manage better the environmental impacts of, and relations between, fertilizer production, transport and storage.

While the fertilizer distribution systems are described in detail, it is not the focus of this report to present a systematic and quantitative analysis of all the environmental impacts of fertilizer distribution systems. More in-depth studies involving other stakeholders such as fertilizer distributors will need to be carried out if such an analysis is to be achieved and technical guidelines for good practices are to be developed.

The Global Reporting Initiative (GRI) was established in late 1997 with the mission of designing globally applicable guidelines for preparing enterprise-level sustainability reports. Participants include corporations, non-governmental organizations, consultants, accountancy organizations, business associations, universities, and other stakeholders from around the world. The GRI seeks to establish a common framework for enterprise-level reporting on the linked aspects of sustainability: the environmental, the economic and the social. It seeks to elevate enterprise-level sustainable development reporting to the level of general acceptance and practice now accorded financial reporting. GRI also seeks to develop and advocate greater stakeholder awareness and use of such reports.

2. Forms and conditioning of fertilizers

Note: In this publication:
The term "distribution" relates to the movement of fertilizers from the plant to the farm, not to distribution in the field.
Mt = million tonnes.
Kt = thousand tonnes.

2.1 Definitions

The terms used in this document to describe the different forms of fertilizers are as follows:

Straight fertilizers, containing a declarable content of only one of the plant nutrients nitrogen, phosphorus or potassium.

Compound, multinutrient fertilizers, containing at least two of the nutrients nitrogen, phosphorus or potassium, which may be further divided into:

- ***complex fertilizers***, obtained by chemical reaction, in which all the nutrients are present in each granule (also called "chemically mixed" and "chemically granulated" fertilizers), and
- ***mixed fertilizers***, being physical mixtures of different nutrients, without a chemical reaction.

Mixed fertilizers may, in turn, be divided into:

- *powder mixtures* (now rare for agricultural use in Europe and the USA),
- *blends* of different materials of matching granule size, which may be delivered to the farm either in bulk (bulk blends) or in bags.

Today, the farmer normally demands granulated compound fertilizers. Granulated complex fertilizers are normally produced in large-scale, often integrated plants. Smaller scale processes include:

- Compaction.
- The steam or water granulation of dry mixes, sometimes called the granulation or fusion blend process.

Fluid fertilizers may be divided into anhydrous ammonia, clear solutions and suspensions. The latter are normally multinutrient fertilizers, the suspension being used in order to increase the nutrient concentration of the product.

The "**Intermediate Bulk Container**" or "IBC" or "mini-bulk sack" is a "big bag", normally containing between 500 and 1000 kg of fertilizer.

In this publication, phosphate and potash may be expressed as their elemental forms P and K, or as their oxide forms, P_2O_5 and K_2O. Some of the abbreviations used for fertilizer products are:

AN	Ammonium nitrate
AS	Ammonium sulphate
CAN	Calcium ammonium nitrate
UAN	Urea ammonium nitrate solution
MOP	Muriate of potash = potassium chloride
DAP	Diammonium phosphate
SSP	Single superphosphate
TSP	Triple superphosphate
NPK	A complex fertilizer containing all the three nutrients.

2.2 Factors influencing fertilizer distribution systems

There is an infinite number of ways of getting fertilizers from the plant to the farm if one takes account of the possible combinations of options in transport, storage, handling, the form of the fertilizer, the conditioning etc. Every situation is unique and there is no "best" system. The cost of getting fertilizers from the plant to the farm accounts for a substantial proportion of the farm-delivered cost when all the items are taken into account. Furthermore, while the manufacturer often has little scope for making further economies in the production costs, the distribution system may offer further opportunities.

It is not just a question of economics. The efficiency of getting fertilizers from the plant to the farm determines whether the products are available when and where the farmer requires them, and whether he has access to products suited to the crop and soils to which they will be applied. This affects the efficiency of the use in agriculture of the products, with impacts on food production and the environment.

Natural conditions

Important factors influencing the fertilizer distribution system include the geography of the country, climate, the structure of agriculture and the type of farming.

West Europe may be cited as an example, where the proportion of the national area accounted for by arable and fertilized grassland ranges from a high of 58% in Denmark to 21% or below in Spain, Greece and Portugal. Fertilized grassland as a proportion of the effective agricultural area varies from 88% in Ireland, through 54% in the UK and the Netherlands to virtually zero in Greece. Farms over 50 ha range from 80% of the total farmed area in the UK to 5% in Greece. As a proportion of the total number of farms, farms over 50 ha account for 33% of the total number of farms in the UK, to 0 to 2% in Greece, Italy, Portugal and the Netherlands. Evidently, the small farms in the Netherlands are mostly intensively farmed, whereas those in the southern European countries can be classed as peasant farms.

Infrastructure

One of the most important factors influencing fertilizer distribution is the development and standard of the road and railway system, the availability of water transport, or even a pipeline system (USA). In many developing countries the density of the roads is scarce (Africa 5 km/100 km^2, Asia 45 km/100 km^2, United States 95 km/ km^2, Europe 350 km/km^2).

In the industrialized countries the life of a truck is considerably longer than in Africa, for example, due to the much better infrastructure. It might be mentioned, however, that the life of a truck depends also on how it is maintained. In several Asian countries trucks have a long life because of the caring attention they receive from the families who own them.

Seasonality

The timing of fertilizer application is determined by the overall cycle of crop growth, by weather conditions and by the type of agricultural activity. Nitrogen, for example, is required mostly during the period of active crop growth. The application of phosphate and potash fertilizers is not concentrated to such a degree into one short period. Nevertheless a peak also occurs during a relatively short period.

In the case of West Europe, around 80% of the fertilizers used, i.e. about 35 million tonnes of fertilizer material, have to be made available for the beginning of the season. However, the most efficient way to operate a fertilizer production plant is to manufacture all year round. Until a few years ago, the problems of matching continuous production with seasonal consumption were solved by using a progressive price structure, i.e. one which offered products at a discount in the off-season, thus allowing the retailers and cooperatives to recover the cost of fertilizer storage. As the market share of importers has

risen, however, pressure on fertilizer prices has increased and the system of progressive pricing has become more difficult to maintain. Retailers and cooperatives are nowadays less willing to store fertilizers, because they want to minimize the financial risk involved.

The product consumption pattern and nutrient concentration

The consumption pattern of the different products has changed. Since 1973/74, most of the increase in world nitrogen consumption is accounted for by urea, most of the phosphate by diammonium phosphate and the potash market is dominated by potassium chloride. Each of these products has a relatively high concentration of plant nutrients. The higher the concentration of plant nutrients, the lower the distribution, storage and handling costs per unit of nutrient and this, no doubt, has been an important factor in the preference. Urea has the added advantage that it makes use of by-product carbon dioxide from the ammonia manufacturing process. These are *not* agronomic criteria.

2.3 Forms of fertilizers

Complex fertilizers

Complex fertilizers, produced by both the ammonium phosphate and the nitrophosphate routes, have many advantages. They have high quality, stable granules, with all the nutrients of the guaranteed formula present in each granule. Their quality is carefully controlled to industrial standards, which guarantees that their nutrient content is within the tolerance limits specified in relevant fertilizer regulations. The granules are free-flowing, resistant to moisture and physical damage, easy to handle and can be applied evenly. The products are screened to ensure that the granule size conforms to a tight specification. Anti-caking agents are applied. Secondary nutrients and micronutrients can be easily incorporated. A wide range of grades is available, to suit any agricultural situation.

Evidently, this quality has its price and complex fertilizers are more expensive than blends of commodity materials. The manufacturer has a wide choice of raw materials but the processing and conditioning has to be paid for. The number of grades requires complicated distribution and inventory control. The investment cost for a new vertically integrated plant is high.

Blends

Bulk blends account for some 80% of solid compound fertilizers in the USA compared with 25% in Europe. The development of blends in the USA is due partly to the location of fertilizer production and consumption, which favours handling in bulk - liquid and solid - and it favours blends. The production points of the primary materials are located far from each other, phosphates in Florida and the South East, potash in Canada or New Mexico, nitrogen on the Gulf Coast. These materials need to be brought together in yet another location, the major consuming area of the Corn Belt. The fertilizer ingredients, produced in large, cost-effective plants, are transported to the area of consumption and mixed there. The river transport facilities to the Corn Belt and, in the case of fluid fertilizers, a well-developed pipeline system, have facilitated these developments.

The growth of blending has been favoured by mergers and acquisitions, the closure of complex fertilizer plants, the wider-availability of low-cost constituents, and the improved quality of these constituents particularly as regards the granule size, uniformity and stability, and the availability of “big bags”. It is estimated that 4 million tones of blends were produced in 1987, 5.6 million tonnes in 1997. To these figures must be added the blended fertilizers produced by several large fertilizer manufacturers in West Europe in fully automated, large-capacity plants, producing an excellent product, often *bagged* and sold through the established marketing networks. In Ireland, for example, all the NPK compounds are produced in this way.

A major advantage of the blending system is the relatively low initial investment required, unlike the case of the integrated complex fertilizer plant. The plants now available are simple and robust. Leading companies can supply purpose-built installations that can be as simple as a mixer on a concrete pad or a highly automated and integrated plant capable of producing 200 kt/a of blended product. Blending plants are relatively inexpensive to build and operate, they can be located almost anywhere as long as granular materials can be transported to their location. Production can be switched on and off according to seasonal demands and short production runs are possible. Almost any grade, suitable for almost any soil and crop requirement, can be made from a relatively small number of fertilizer materials. Advantage can be taken of low prices for the fertilizer ingredients on the international market.

A problem with blends, especially bulk blends, is the segregation of the constituents during transport and storage, unless the granule sizes are well matched. Bagging can limit segregation. Also the effective economic operating radius for bulk deliveries is limited. While further progress can be made, there has been a considerable improvement in the quality of bulk blends. Codes of good practice have been prepared.

Granulated and compacted blends

Dry mixing of powdered fertilizers can be traced back to the early 1900s but difficulties of storage, handling and dustiness etc. precluded their widespread acceptance. A relatively new technology is to compact powdered dry mixes of straight fertilizers or their intermediates to form granules.

Granulated or fusion blends, have become well established in India. Almost all raw materials can be used and a variety of grades manufactured.

2.4 Conditioning of fertilizers

50 kg bags

In the 1920's and 1930's fertilizers in West Europe were handled in large jute bags (about 100 kg). These were popular with farmers since they could subsequently be used for other purposes. From the late 1940's these were replaced by 50 kg paper bags which, in turn, were replaced by plastic bags in 1960's. It was from the late 1960's that the large-scale development of mechanized systems of handling fertilizers developed in countries where the agricultural structure provided a strong demand for such systems.

Bags offer several advantages. They are easy to transport, store, measure and identify. They protect against moisture and limit segregation if this is a problem. They permit a guarantee of weight and quality and help to protect the customer against fraud and adulteration of the product. Palletization facilitates handling and shrink-wrapping provides additional protection during storage. All these measures evidently add to the cost, but this is a cost which can, under some circumstances, be justifiable.

The general use of welded plastic sacks has led to a simplification of storage conditions. Although it is may be possible to store these bags in the open air for a few weeks, covered with a plastic cover to protect them from rain and the sun, it is preferable to shelter them in a clean store, isolating them from the ground end the walls, to avoid substantial humidity differences and rodent attacks.

In regions where farmers do not need highly mechanized systems, due to the small size of the farm, difficulty of access etc., the traditional 50 kg bag is likely to remain the main distribution method. Its simplicity and flexibility outweigh possible cost-savings in dispensing with the bag. Free bags are usually transported manually to the trailer, then to the spreader.

The physical effort of handling 50 kg bags is resolved by the use of "big bags" or palleted bags, if the farmer is equipped with suitable lifting equipment on his tractor. In West Europe at least, the palletization of bags is now common practice. Palletization avoids breakage in the distribution chain and the fertilizer can be delivered on pallets to the farmers. Storage on the farm can then be effected in different ways; traditional storage in a hanger, on pallets, or on towed trailers.

Bulk

The bags and the bagging operation add to the cost of the finished product. Handling in bulk facilitates mechanical handling, so that the effort is reduced, less labour is required and the handling speed is increased. However, this too has a cost, which is greater than is sometimes realized, especially if the total cost, from plant to farm, for the total quantity delivered, is taken into account. For example, the investment cost per unit quantity handled may be higher due to smaller loads and the need for special vehicles and conveyors. Store-houses which provide more protection than that needed for bagged material may be required. Furthermore, unless it is well managed, transport and storage in bulk can lead to high product losses.

In Europe, bulk is justified when more than about 50 tonnes is handled on the farm, with at the most three grades. Storage can be effected on raised hoppers, or in stalls in a store, protected from humidity, of easy access, with access ways and a height sufficient to permit delivery and reloading of the fertilizer.

For up to 15/20 tonnes handled per agricultural worker per year, bulk is not indicated. Above 50 tonnes, bulk is recommended. Between the two, the big bag is often a viable solution.

The user of bulk can obtain his supplies directly from the distributor, either from his store, or from raised silos from which the fertilizer falls into his trailer through gravity. This solution is valid only for short distances between the point of supply an the field (not more than a kilometre per tonne of fertilizer transported). The reloading of bulk stored on the farm implies most often the loading of trailers using a tractor bucket, of a conveyor or a screw conveyor, or sometimes simple gravity. Various adaptable accessories of commonly available equipment permit manual unloading of fertilizer from the trailer into the spreader.

Intermediate Bulk Containers, IBCs

The use of IBCs, which are intermediate between bulk and the 50 kg bag, has become significant in some countries. Their handling can be completely mechanized, they are easy to store, the factory to farm investment cost is considerably less than that of bulk, and the bags can be labeled. IBCs permit a substantial time saving by eliminating arduous handling. Relative to bulk, IBCs permit a substantial economy in investment in handling and storage facilities.

These are often of 500 or 1000 kg, and are, as their name implies, intermediate between the 50 kg bag and bulk. Their advantages are that:

- their handling can be completely mechanized,
- they are easy to store,
- the factory to farm investment cost is considerably less than that of bulk,
- in the case of bags, they avoid the cost of a pallet and/or shrink wrapping,
- they are handled fewer times than 50 kg bags, hence losses are reduced.

The disadvantages are that:

- the distributor and the farmer must have a fork-lift or similar,
- the big bag is more expensive than the equivalent number of 50 kg bags,
- investment in bagging facilities is required.

IBCs have found a place especially where handling as solid bulk was not previously established.

Fluid fertilizers

Fluid fertilizers such as urea ammonium nitrate, UAN, offer the farmer the advantage of reduced manual handling and the opportunity to apply fertilizers and some plant protection products at the same time. UAN is easy to handle and spread accurately. However, they require special storage facilities, transport containers and application equipment.

Fluid fertilizers have found less favour in West Europe than in the USA. If the liquid fertilizers are transported by road tankers, which is the case in Europe, there can be bottlenecks, particularly at the peak season, especially since farm storage is normally limited. In the USA liquid solutions are transported over long distance by pipeline. Fluid fertilizers require adaptation of the distribution system; this is expensive in a market with little demand growth. In Europe the total investment cost for liquids (transport, storage and handling) tends to be higher than that of solid fertilizers. Under US conditions the converse is the case.

In the USA, the major UAN producers own large fleets of UAN railcars. Mild steel UAN storage tanks at terminals have a 4,500-9,000 tonne capacity, but major terminals have tanks with 27,000 tonne capacity. The current cost of a new 27,000 tonne UAN storage facility (carbon steel tank, containment dike, pumps, piping, and electrical fittings) is approximately US$ 1 million, compared with US$ 450 000 for solid bulk storage warehouses of traditional construction of about 9,000 tonne capacity. At the retail level, storage tanks for UAN vary in size from 450 tonnes for small dealers up to 1,800 tonnes for larger dealers.

In Europe, UAN is most commonly used in France. The product is normally stored in tanks containing of 15 to 50 000 litres, in anti-corrosion treated or stainless steel or reinforced plastic. There are also 3000 litre tanks for short-term storage or transfer to the field. Storage facilities of less than 100 m^2 are subject to relevant departmental health regulations, above 100 m^3 they are subject to authorization.

As solid fertilizers spreaders fluid fertilizer equipment should be thoroughly cleaned after use. In order to avoid blockages and corrosion the equipment should be emptied and rinsed and the pumps cleaned after each period of use.

Suspensions

Solubility properties limit the concentration of clear liquid solutions, but the concentration can be increased by preparing suspensions. The storage of suspensions requires equipment for regular agitation at intervals of a few days, using compressed air. Most often, it is the regional distribution station which assures the storage of base products and the preparation of grades shortly before use. They have a limited radius of operation from the mixing unit (about 15 miles on average in the USA). As with clear liquids, suspensions are used more commonly in the USA than in Europe where they have to compete with established and efficiently produced NPK solids and with blends.

Gaseous fertilizers - Anhydrous ammonia

In the USA, 32% of nitrogen application is in the form of anhydrous ammonia. The product has the advantage of a low price per unit of N, but it requires special equipment for transport, storage and injection, i.e. high-pressure storage tanks and injection machinery. Strict precautions need to be taken in its handling, and regulations have to be respected. These considerations together with the problem of distributing the product by road have prevented development of the use of the product in Europe. The use of directly applied anhydrous ammonia developed to a significant extent only in Denmark, but even there it is no longer used.

3. Costs and management systems

3.1 Marketing costs

FADINAP, the "Fertilizer Advisory, Development and Information Network for Asia and the Pacific" of ESCAP/FAO/UNIDO, has carried out regular surveys of fertilizer marketing costs and margins in the countries of Asia and the Pacific.

The cost of transport is normally the largest single item in the total marketing costs. In many of the countries the percentage of transport costs in the total marketing costs is around 50%. The second most important item is storage costs, including the cost of financing the storage of the product.

(In West Europe, it has been estimated that logistical costs, including handling, transport and storage, represent about 20% of the price paid for fertilizer by the farmer. Road, rail, canal, river and sea transport systems are used, depending on the local infrastructure).

In the FADINAP survey, in most cases, the assessment of the costs is complicated by the involvement of the public sector and open and hidden subsidies. The hidden subsidies may be in the form of special rates from public transportation companies, reduced storage costs, the overhead costs of public institutions etc.

Countries do not appear to identify all costs associated with marketing when calculating the selling price to the farmer, many costs being lost in general operating expenses of parastatal or government ministries and others, such as opportunity cost of capital, being ignored completely.

Trade margins are recorded but are very low in most cases. In some cases fertilizers are distributed by government agencies, in others private traders are reluctant to report accurate figures. The reported margins are so low that it is evident that the retailers provide little or no service.

The following text is extracted from the *Summary results of the survey on fertilizer marketing costs and margins in Asia and the Pacific, 1996/97* by Edgar Dante, FADINAP, Agro-chemicals News in Brief, July-September 1998.

Transportation costs

Fertilizer is a bulky product, thereby requiring high costs for transportation. In this survey, transport cost refers to the cost of transporting a ton of fertilizer from port or factory to the survey area. Transport costs ranged from as low as US$ 2.0 per ton in Fiji to a high of US$ 45.8 per ton in Indonesia. Such differences do, of course, reflect not only variations in transport cost per km but more so the distances that fertilizer is carried. The relatively low transport cost in Fiji is understandable for a very small country. However, in Indonesia, fertilizers have to be transported by boat and truck for an average distance of 1,600 km from factories in Palembang to the main consuming areas in Java. Transport costs in this country accounted for 84 per cent of total marketing costs.

An important factor contributing to high overall transport costs is the insistence of some governments that fertilizer be made available to all farmers even in the most remote areas. Not only does this increase average fertilizer transport costs, but the higher food production which results from fertilizer availability must, in turn, be transported to the markets at similarly high costs. This means that those food producers who, by reason of their location, are best placed to produce for the market are penalized by having to absorb the costs associated with transport to and from remote areas.

Storage and financing costs

There is a need to store fertilizer at almost every level of the distribution system, that is, at import, wholesale and retail points. Closely related are costs of financing of stocks, which cover the interest during the period between purchase and sales of fertilizer. This cost item constituted a significant element in the total marketing costs in many countries. In some countries, financing costs were not reported or were even neglected. In such cases, financing cost may be considered to form a part of the reported margins for importers, wholesalers and retailers.

Long storage periods imply significant interest charges, which unfortunately many countries failed to account. The failure to identify the opportunity costs of capital, not only gives a misleading impression of the efficiency of the marketing system, but also results in either the farmer being undercharged for fertilizer, or in the levels of subsidy being understated.

Other costs

Other costs include various components not covered in the above, such as administration charges, clearance and handling costs for imported fertilizers, promotion activities, overhead charges, interest charges, etc. In some countries, a number of these items are incorporated in the transport, storage and financing costs.

Marketing margins

The Philippines gives a good indication of the total marketing margins of importer, wholesaler and retailer which was about US$ 10 per ton, representing about 14 per cent of the gross marketing costs of US$ 73. This total marketing cost of US$ 73 was 31% of the retail price of US$ 234. This being imported material, some US$ 20 of sea freight might be added to the gross marketing cost, to bring it to 40% of the retail price.

In Bangladesh, wholesalers and retailers of locally produced urea earned a total of US$ 12 per ton as margin.

Table 1 gives investment and operating costs from a US case study. The case study concerned the establishment of a marketing and delivery system, covering an area of 30 km radius, and which covered 60% of the farmed land. The area was located 200 km from the fertilizer factory. There was a two-step delivery system (intermediate regional storage and local storage). The median fertilization rate was 120 kg NPK/ha.

Marketing and delivery costs in this case study amount to between 30% to 50% of the ex-factory cost of the fertilizer.

Table 1. Case study: investment and operational costs of fertilizer distribution

Investment cost element	**US$**
Buildings	
Storages	2,000,000
Laboratory	120,000
Offices	100,000
Trucks	800,000
Operation cost element	**US$/t**
Labor and staff	18.0
Transportation	8.5
Depreciation	5.0
Financial costs	5.5
Insurance	1.4
Market promotion	5.0
Return on sales	15.0
Total	58.4

Source: IFDC

(The total is of the same magnitude as that observed in the Philippines, mentioned above).

Integration of the delivery system for fertilizers with that of other agricultural inputs (plant protection products and animal feed) and farm outputs may substantially decrease the operational costs of the delivery system.

3.2 Management systems - India

The following text is an example from **India** edited and extracted from *Distribution. An Important Arm of Marketing* by K. Parthasarathi, Fertilizer Marketing News, Vol. 29 No. 12., Fertiliser Association of India, New Delhi, December 1998.

The distribution system

An ideal distribution system is one that enables the right product to be available at the right time, in sufficient quantities and at most economical cost at the consumption centres. In India, the distribution function assumes greater importance than in many countries for the following reasons:

a. *Production is concentrated in coastal areas for reasons of logistics;*
b. *Imports also are concentrated in the same coastal centres;*
c. *The area of consumption is spread over a very large area, mostly inland;*
d. *Production is continuous while consumption is seasonal;*
e. *Transport facilities are inadequate and have to be shared with many other commodities;*
f. *Silo and transit storage capacities are limited;*
g. *Extensive retail network;*
h. *Inadequate attention is paid to customer service;*
i. *Promotional activities are inadequate due to financial constraints.*

The demand and supply of fertilizers are substantial and the products are easily inter-changeable. A good distribution system facilitates effective customer service.

Distribution costs

Unlike manufacture, distribution lends itself easily to trade-off economies i.e. where a deliberate increase in unit cost of one activity can result in greater savings by way of reduced unit costs of another activity or activities.

Therefore, the distribution function is an area where constant scrutiny of costs and of strategy can result in real economies. The major items in distribution costs are:

a. *Terminal costs, cost of packaging, handling at factories or transit area;*
b. *Inland freight;*
c. *Warehousing costs such as inventory holding, storage rental, depot handling, documentation etc.;*
d. *Cost of re-bagging, standardization at the warehouse, loss due to handling, pilferage etc.;*
e. *Covering risks against accidents and natural calamities.*

Since the inventory carrying cost is a major component of distribution costs, every effort has to be made to reduce this cost item. A careful balance between demand and supply by means of effective demand forecasting is necessary.

Need for integrated approach to distribution

The channels of distribution are the same for both indigenous and imported fertilizers. All aspects of distribution must be integrated to achieve economies. Such an integration should be inter and intra - organizational, inter and intra-regional etc. involving producers, importers, the transporters and the consumers, in order to achieve operational economy. A long-term plan based on the experience of each agricultural season permits optimization and economies in the distribution network.

The regional warehousing concept has gained ground. It creates buffer stocks which permit the most effective distribution in a region where large volumes are involved over a short period. Such a system helps to minimize damage to material and packing, apart from meeting the demand effectively.

Distribution planning and management

The planning and management of distribution have become complex operations and involve selection and application of the best combination of different

independent alternatives. The operation is concerned not only with the price paid for the product, or with the selection of the agencies for activities such as transportation or warehousing, or with simply avoidance of wastage or damage in handling or packing, but also with the impact of the entire group of activities considered collectively. Handling methods, packaging alternatives, time in transit, warehousing and inventory costs, costs of intra-plant and port movements, operational innovations to overcome seasonal or chronic bottlenecks, lead time to create infrastructure and the costs of operating the same, flexibility to shift stocks to meet sudden and sharp demand or withdraw from drought hit areas etc., are all part of distribution planning and management.

There is need for careful and accurate calculation of transportation or handling costs and their relation with other factors such as inventory and other costs and customer service requirements. This calls for technical skills and managerial expertise. With computerization, a manufacturer can choose appropriate distribution and transportation models.

Today the Fertilizer Distribution Manager is involved in a broad and complex range of activities, far beyond those of a transport manager.

Transportation

The three main activities related to transport logistics are :

- *Loading from plants or ports;*
- *Dispatch by rail or by road;*
- *Unloading at rail terminals, warehouses etc.*

Fertilizer is just one of the bulk commodities transported by rail or by road. Movement by rail is, by and large, from point to point, in unit trains. Nearly 40% of the total fertilizer traffic is conveyed by rail. A substantial rail network throughout the country helps in the speedy movement of the material. However, owing to ever-increasing pressure of traffic and lack of commensurate resources, the railway infrastructure is under tremendous strain, due to demand from other sectors. Therefore, to meet the challenge, the railways authorities are implementing gauge conversion and are also introducing an 'Own Your Wagon' scheme. To keep the operational cost as low as possible, movement by rail is the preferred route. Movement by road is generally confined to nearby areas, except for occasions when long distance transportation is necessary due to an inadequate supply of wagons.

Unloading at rail terminals is still done using conventional methods. This takes a longer time leading to retention of wagons at the terminals, thereby incurring higher demurrage charges. To improve the handling at the terminals, the following areas needs to be given attention:

a. *Explore new types of wagons which can carry higher tonnage and withstand high speeds;*
b. *Examine a multimodal transport system wherever possible i.e. river, sea, rail and road;*
c. *Palletisation of fertilizer bags with a lifting capacity of two tonnes each;*
d. *Sliding door wagons could be explored to load pallets;*
e. *Acquire forklifts for each loading and unloading terminal;*
f. *Explore movement of fertilizers in bulk - develop a matching infrastructure.*

Handling at ports

In the context of the total rationalization of transportation of fertilizers, it is imperative to adopt an integrated approach in respect of both domestic production and imports. In India, the ships carrying imported fertilizers are handled at eleven major and as many as fifteen minor ports to economize in distribution and make the fertilizers available in the shortest possible time. The total imports of urea, DAP and MOP are expected to reach 12.8 million tonnes during 2001-02, depending on the domestic price. At present the rated capacity for fertilizer handling is around 8.0 million tonnes at the major ports and nearly 2.0 million tonnes at the minor ports. Decontrolled fertilizers are mostly handled at selected ports. Therefore the optimum port capacity utilization requires a perfectly matched rail - road transport capacity at the port.

The operational constraints at the ports seriously affect the discharge and evacuation of fertilizers. The ports have high labour costs, low productivity, inefficient equipment maintenance and obsolete technology. Although overall operations at the ports have shown improvement in terms of the ship turnaround time and output per ship berth day, they have been showing signs of stagnation in the last few years. As a first step forward to improving port handling, the major port trusts have been delegated powers which are similar to those delegated to public enterprises. It is being considered to convert some of the ports into public limited companies to give them more autonomy in their functioning. Also, some of the berths have been privatized to help develop infrastructure facilities on long term basis.

Storage

Warehousing is an integral part of distribution. Since the inventory carrying cost (ICC) is a major component of distribution costs, every effort has to be made to reduce this element. However, this is a very delicate issue which requires a fine balance of conflicting interests i.e. making the fertilizers available in the required time frame and the need to reduce ICC. The conflict is all the greater in view of the skewed pattern of fertilizer consumption in our country. In order to reduce the ICC, the importer, particularly of decontrolled fertilizers, tries to bring in the material as close to the peak consumption period as possible. Of course, the trend of fertilizer prices in the world market and fixing of concession prices also have an important bearing on the timing of the imports. Nearly, 60% of the material is imported in April to September and remaining 40% during October to March.

4. Transport

4.1 International trade in fertilizers and their raw materials

Fertilizers and their raw materials are an important constituent of sea-borne bulk trade. They take fourth place among bulk commodities in world shipping trade after iron ore, coal and grains. In 1996 some 112 Mt of fertilizers, phosphate rock, potash and sulphur were shipped, accounting for 6% of all sea-borne bulk trade. The grain trade, for comparison, amounted to 199 Mt. The lower the value of the shipped material, the greater the incidence of transport in the landed cost. Evidently phosphate rock at an FOB cost of US$ 50 per tonne has a bigger transport component than DAP at US$ 200 per tonne, but both materials can be considered to be relatively low-value bulk commodities. It is therefore most important that the port handling system should be modern and effective, with sufficient capacity to maximize the efficiency of handling and to minimize demurrage penalties. It is also important that spillage should be minimized, for both economic and environmental reasons.

A notable feature of international trade in fertilizer materials is the development of the movement of urea, the ammonium phosphates and potassium chloride. It is no coincidence that these are all products with a high nutrient concentration, and the main constituents of blends. A simple calculation demonstrates that an increase in concentration from 30% to 40% results in a 25% reduction in the transport and handling costs, an increase from 40% to 50% in concentration in a 20% reduction.

The following text is extracted from *Improvements in Fertilizer Handling Technology and Equipment* by L. Jarskog and K. Bowley, Agro-chemicals News in Brief, FADINAP, July-September 1996.

During the last decade the cost and environmental aspects of dry bulk handling (in shipping) have come more into focus owing to the ever increasing competition in the industry, and the environmental awareness among people all over the world. The crude traditional ways of handling dry bulk have gradually been replaced by more sophisticated, efficient, and environmentally safe systems which satisfy both the operator's cost requirement and the emission limits set by the authorities.

The cost of bulk commodities in general is to a high degree influenced by the transportation cost. This is particularly true in the case of inexpensive commodities such as cement and aggregates, where the transportation cost could reach the same level as the cost of the commodity itself. Phosphate rock with a cost ranging from US$ 50 to US$ 70 per ton also has a very big transportation cost component in the total cost, while fertilizers at a cost of say US$ 150 are to a lesser degree dependent on the transportation cost. Included in the transportation cost is the cost of loading and unloading the ship in port. This cost has two components, the direct cost of the loading or unloading operation, and the cost of having the ship idle in port. The latter can reach very high levels when ineffective handling systems are used, and the operator is forced to pay excessive demurrage penalties particularly for the unloading operation, which is often complicated and time consuming.

Unfortunately, many times, only low capacity, low cost unloading equipment is considered when planning to import a terminal, a decision which, at a later stage can prove to be very costly for the importer. Not only can the unloading capacity be a cost increasing factor but the size of the unloading equipment can also limit the ship size to

uneconomical vessel tonnage, which will further aggravate the situation. Modern handling systems using state-of-the-art technology can accommodate ships of any size and provide high unloading capacity in a most cost effective way.

The ever increasing requirements for environmentally safe bulk handling operations can only be satisfied with thoroughly engineered plants using enclosed dust free continuous systems. Existing old bulk operation equipment in various ports, seldom corresponds to the environmental standard required today, and are costly to operate because of the spillage and dust problems. The spillage and dust emission from bulk operations are not only an environmental problem but also an important cost factor. The spillage has to be picked up from time to time and the area exposed to the dust cleaned on a regular basis. Furthermore, the spillage represents loss of valuable material which has to be paid for by someone, in the end.

4.2 Sea transport

As with most bulk products, the shipping of fertilizers and fertilizer raw materials is affected by economies of scale. Normally, the larger the cargo carried, the lower the transport cost per tonne. However, an importer must also consider the port facilities available at the port of discharge - the length of the jetties available, method and speed of unloading and whether or not port storage is available. These factors will determine the maximum size of cargo that can be safely handled.

In West Europe, for example, much of the potash moved from Hamburg to fertilizer factories within Europe is moved in relatively small shipment sizes of about 3-5,000 tonnes. The shipping cost is somewhat higher than could be achieved with larger shipment sizes but on the other hand stocks at the receiving port can be kept at a manageable level. This can be compared with urea from the Black Sea to China where shipments are normally about 50,000 tonnes. This reduces the shipment cost over the long sea haul to a minimum but means that substantial storage must be available at Chinese ports of discharge. At some Chinese ports, substantial quantities of bagged urea must be stored outside under tarpaulins which is never ideal.

A major factor that leads to high freight costs in many ports is the slow speed of discharge. For example, if the shipment size is 20,000 tonnes and the discharge rate is only 1,000 tonnes per day then it will take about 20 days to unload the ship. If the discharge rate can be increased to, say 5,000 tonnes per day, then this reduces the time required to only 4 days. Extra days add to the cost of lay days and demurrage which can be of the order of US$ 8-10,000/day. Factors that increase/reduce the speed of discharge are:

- Number and type of cranes available and the general reliability of equipment;
- Types of hoppers and conveyors;
- Size of bulk store available at quayside;
- If there is no bulk store, the speed of bagging at quayside; if bagging is under cover then it is less affected by weather conditions. If bagging is alongside the ship then wet weather will halt operations and cause delays;
- If the bagged fertilizer must be immediately loaded onto trucks and moved out of the port area, then the availability of a steady supply of empty trucks will be a major factor determining the speed of discharge.
- It is also normally cheaper to ship in bulk than in bags although, of course, the port of discharge must have suitable equipment to discharge bulk cargoes. Another argument in favour of bulk is that bagging is almost always cheaper in developing countries where labour costs are lower. If the country has bag making capacity and can produce bags of the right quality, these are also likely to be cheaper in the developing country. There is also a saving of foreign exchange.

4.3 Transport regulations

Transport regulation is often supra-national being embodied in international agreements such as the IMDG Code for sea transport, the European agreement on the carriage of dangerous goods by road (ADR) and the Regulations concerning the carriage of dangerous goods by rail (RID). The United Nations have published Recommendations on the Transport of Dangerous Goods (the so-called "Orange Book").

Controls on the transport of fertilizers are limited to those products which are classified as hazardous (dangerous) goods. In general terms this means those products classified as "oxidizing" due to the high concentration of ammonium nitrate (UN classification Group 5.1). There is a much smaller group of products which can exhibit self sustaining decomposition, where thermal decomposition, once started, will continue even if the source of heat has been removed. Such products are known as "cigar burners" (UN classification Group 9).

Probably the most important aspect of all the transport legislation and the one which is common to all modes of transport, is the need for careful labeling of packages so that the type and degree of hazard can be readily identified in any country. In the case of bulk loads, by land or sea, the relevant information must be included in the documentation which must stay with the material and be readily available to the authorities at all times.

One of the most comprehensive publications dealing with classification is the IMDG Code and the classifications in this Code (Explosive, Toxic, Corrosive, Flammable, Oxidizing etc) are accepted throughout the world. Classification is generally based on recognized test procedures such as those in the United Nations "Orange Book". The IMDG Code gives specifications for hazard labels and placards, with full illustrations. These specifications and symbols are used in virtually all national labeling legislation. It forms the basis for EC Directives on Classification, Packaging and Labeling of Dangerous Substances (Directive 67/548 EEC and subsequent Amendments).

International transport law is upheld through the United Nations and international organizations such as IMO. Sanctions might include the prevention of vessels from entering harbours or preventing lorries or trains from crossing national borders.

Sea transport

All sea transport is governed by IMO which is supported by all maritime nations in the world. Regular updating of the IMDG Code ensures that new materials and hazards are covered. The Code imposes restrictions on the types of vessel which may be used, the quantities which may be carried and the form in which they may be handled.

Classification is based on a number of properties such as explosive, oxidizing and toxic, with appropriate methods of test to establish the classification. Within the classifications products, such as fertilizers, may be sub classified according to composition.

The IMDG Code is also concerned with other hazards such as cargo stability and provides test methods for properties such as the angle of repose of bulk materials.

Road transport

Internal transport is normally covered by national regulations which may be based on international agreements such as ADR in Europe. Such regulations not only cover the labeling of the products but also the definitive marking of the vehicles, specification of the documentation required and, in many cases the need for driver training in case of emergencies.

Rail transport

As with road transport, internal rail movements are normally subject to local regulation, with cross border transport covered by international agreements such as the RID in Europe. These

agreements also cover the labeling of packaged goods and transport documentation.

Inland waterway transport

Cross-border traffic is covered by international agreements such as the European provisions concerning the international carriage of dangerous goods by inland waterways (ADN) or regional agreements such as the Regulations for the carriage of dangerous substances on the Rhine (ADNR).

Air transport

Because of the large scale trade in fertilizer materials, there is virtually no air transport of fertilizers apart from small sample quantities. Such transport is covered by the International Air Transport Association (IATA) rules.

4.4 The transportation system in the USA

Annual distribution of 48 million tonnes of fertilizers from factories and ports to approximately 13,000 retail outlets is a complex and costly year-round process. The efficient bulk commodity distribution system that has been developed over time in the United States has enabled fertilizer to be efficiently distributed, particularly into the main fertilizer use areas of the Midwest. However, transportation costs are increasing and are likely to continue to do so. Cost-effective road transport distances are approximately 100 miles. Beyond this distance, rail and barge transport are considerably more cost effective. There has been considerable consolidation in these two transport areas. For example, in 1970 there were over 50 class I rail carriers; by 1980 the number was 20, and in 1997 there are only six. Four carriers account for 80% of all rail freight. The typical dry cargo-fertilizer rail car has a capacity of 90 tonnes). Dedicated unit trains are used where possible, for example in transporting potash from Canada and DAP from Florida to the Midwest. Anhydrous ammonia and UAN rail tankers are owned by several fertilizer companies in addition to those owned by railroad companies.

The large barge companies own, lease, or contract with river terminals, but many river terminals are operated independently. The average barge transportation and handling costs between New Orleans, Louisiana, and St. Louis, Missouri averaged about US$ 11 per tonne in 1997, of which half was accounted for by transport and half by loading and unloading. In comparison, typical transport costs for rail and road from New Orleans to St. Louis were approximately US$ 33/tonne and US$ 52/tonne respectively.

In the barge industry, the number of covered barge operators declined from 42 in 1990 to 37 in 1996. The five largest companies operate 7,400 barges with a typical capacity of 1400 tonnes in a single hold. This represents about 65% of the total U.S. covered barge fleet of 11,300 barges. There are an additional 6,000 open barges. Three of these largest barge companies are owned by grain companies; fertilizer and other dry cargo provide upriver shipments. It is estimated that about 15 million tonnes of solid fertilizers are transported by barge each year, representing approximately 16% of all dry cargo.

Only about 10% of all AN is shipped by barge. AN is the only solid fertilizer cargo that is regulated for barge transportation. Barge shipments must follow the AN safety protocol.

Each barge containing AN (bulk or bagged) must have on board the following documentation; a permit to haul, bill of lading, draft survey, Material Safety Data Sheet (MSDS) and Emergency Response Procedures and Contacts (telephone/telefax/address). These documents are placed in a water-tight canister that is fastened to the bow of each AN-containing barge in a tow. Additionally, the tow boat for an AN cargo must also carry an MSDS and emergency response papers. The shipper of record must also inform the Coast Guard of each loading.

4.5 Environmental aspects

The following text is extracted from *Responsible Care: 1997 Environment, Safety and Health Report*, BASF, Germany:

Reliable delivery is an important factor behind BASF's success. Our customers need to know that goods they order will reach them on time and undamaged. We package our products as securely as we can to ensure that nothing happens to them en route - an arrangement that benefits not just BASF and its customers but the environment in general. "Wanting products to arrive safely at their destination is the same as wanting them to cause no environmental damage on the way", explains Dr. Wolfgang Dubiel, a transport expert working for BASF Logistics. "We also want to ensure punctual delivery".

But non-polluting transport means more than just secure packaging. The choice of carrier, too, plays a major part in ensuring safety and protecting the environment. When quantities are too small to be suitable for transport by ship, BASF uses the railroad whenever it is technically feasible and economically acceptable to do so. Admittedly, goods are as safe on a truck as they are on a train, but the growing volume of traffic on Europe's highways is a sound reason for BASF to prefer rail to road. In doing so, the company hopes to help avoid the threat of gridlock on the highways. Wolfgang Dubiel summarizes BASF's logistical strategy: "Wherever possible, we try to use the railroad for longer journeys and resort to trucks only for short-haul deliveries to customers".

The following text is extracted from D.M. Martin and R.S.N. Carne (1997):

The other requirements of Product Stewardship can be detailed in documentation prepared for suppliers of contract services related to haulage and storage. Prior to accepting a haulier, the haulier must have agreed to operate to the legal requirements on carriage of the Company's products and have received and accepted the Company' particular requirements. There is often an interesting tension in this process around the legal responsibilities of the haulier who has his own expertise in handling and transport and the Company which with its knowledge and Duty of Care in relation to the product, wants to leave that which is really the job of the haulier in his charge. Currently, the responsibility for protecting and helping a haulier loading and then sheeting down his vehicle is a topic of concern where the statement "the back of the lorry is the hauliers work place" may not be the whole of the story. The position will probably continue to evolve with cases being "determined by the circumstances of any incident".

Accepting a haulier or store to handle the Company's products should therefore be formalised by pre audit, in the case of stores, and documented confirmation of receipt of the Company's Haulage Manual and agreement to work to it, in the case of hauliers. On-going audit is important to determine continuing operation to the required standards.

5. Fertilizer losses

5.1 Information on fertilizer losses

There is little plausible information on the extent of fertilizer losses during the distribution process. In a paper presented at an FAO/FIAC meeting held in Rome in 1982, the following comments were made:

"While fertilizer development, testing, promotion and application have received widespread attention from engineers, scientists and manufacturers, problems associated with fertilizer conservation and loss prevention have not received significant attention. This is reflected in the meager data concerning physical losses and lack of discussion of such problem in fertilizer circles" (T. Byrd and S.K. Reddy 1992).

This is still frequently the case in developing countries. It is difficult to obtain reliable information on losses. Handling losses at the plant are normally minimal; most of the spilled material is recycled although where incidental costs are reimbursed by governments to individual manufacturers could result in more careless management in this respect. However, once the product has left his hands, even in developed countries, the manufacturer has little incentive to monitor the physical losses.

The person with title to the fertilizer at each stage of the distribution process is normally financially motivated to ensure that the losses are kept to a minimum. This is not, however, the case in many developing countries where official bodies are often responsible for fertilizer distribution, among other responsibilities. Sometimes the responsibility is shared between different official bodies and losses can be easily dissimulated. It is therefore not surprising that it is difficult to obtain reliable information on the true extent of losses and the greater the loss, the more difficult it is to obtain the information.

5.2 The extent of fertilizer losses

In FADINAP's 1996/97 marketing costs survey (E. Dante, 1998) estimates of physical losses incurred during handling, transportation and storage of fertilizer were normally based on a certain percentage of the total value of the product. He showed that it is likely that the countries do not have an accurate appreciation of the actual losses, and therefore the cost item is always underestimated. Survey results showed that physical losses ranged from US$ 0.1 to US$ 3.7 per ton. In Fiji, this cost accounted for as much as 5% of the total marketing costs.

The main reasons for fertilizer loss are spillage caused by torn bags, which results in quantitative loss and pollution, damage which results in qualitative loss, and theft. Improved management supervision is essential if losses are to be reduced. In particular, a clear demarcation of responsibility at each stage of transfer is vital to ensure that individual responsibility for losses can be identified. Adequate documentation facilitates monitoring, discourages fraud and encourages efficient performance. There is little incentive for workers to be concerned about reducing losses if management has no means of tracing such losses. It is also important to use durable fertilizer bags to avoid huge losses during transport and handling.

IFA surveys made during the 1980s indicated that in developed countries, losses of bagged fertilizers are negligible. In the U.K. a figure of less than 0.5% was mentioned. The losses with bulk fertilizers were higher; a figure of 0.5% at each handling was estimated (USA) or in France,

as much as 2% at the distributor's store. Of course, these losses are offset by the saving of bagging costs and convenient mechanical handling. Spillage at the manufacturer level is normally recycled (at a cost). Storage losses at the farmer level are believed to be minimal.

During the central planning period losses during distribution and storage in the Former Soviet Union were very high, and especially during the transport of bulk fertilizers (sometimes on open rail wagons). Figures of 20% losses, and more, were cited. The financial incentive to reduce losses is now much greater but it is suspected that further progress needs to be made.

5.3 Factors determining fertilizer losses in handling and storage

In general, the losses can be divided into:

Physical losses

Due to torn, burst or decomposed bags, split seams, spillage of bulk.

Product damage

Caking, loss of plant nutrients following lengthy storage, adsorption of humidity, granule or prill damage, dust, segregation, exposure to weather.

And the extent of losses depends on a number of factors:

The fertilizer type

Some fertilizers are more susceptible to physical degradation than others (e.g. hygroscopic fertilizers).

Fertilizer quality

The resistance of the granules to stress and humidity and their freedom from dust. Quality of the granule coatings.

Pack quality

Losses are more likely with single-ply plastic bags than with the evidently more expensive bags with a heavy-duty outer bag and an inner liner. Single-ply bags may be adequate for the domestic marketing developed countries, but not for export.

Geography

Deterioration of fertilizers is favoured by hot, humid conditions.

Form of the fertilizer

Losses with bulk fertilizers are greater than with bagged fertilizers, except where the latter are handled very carelessly.

Storage facilities

For bagged fertilizers, the stores can be simple but for bulk fertilizers reinforced walls, air-conditioning, etc. are required. The investment cost of such stores is consequent.

Handling in the stores

If bagged fertilizers are stacked too high, caking may result. The skilled use of suitable mechanical equipment can reduce losses, but its misuse can increase them (e.g. the crushing of granules by machines in a bulk store).

Number of times handled

The more often the fertilizers are handled the greater the losses. T. Byrd and S.K. Reddy (1982) quote an estimate that (in certain developing countries) the average bag is handled 10 times and averages 20 holes per bag.

Bad planning

If the procurement is badly planned in relation to demand, the fertilizer may be stored for long periods, with consequent deterioration.

Motivation

Incentives may be given to labourers handling the fertilizers, for example to avoid the use of hooks when handling bagged fertilizers at ports. It is essential that the distributing organization should have the financial incentive to avoid losses.

Theft

Stolen (or smuggled) fertilizers may be well used from an agronomic point of view but, in undermining the financial basis of the distributing

organization, are likely to result in poorer management.

As the above list indicates, losses are more likely to occur in developing countries, with hot humid climates, an insufficient infrastructure which necessitates the fertilizer being handled several times, with inadequate stores, a shortage of skilled labour and management, distribution by people with little motivation to minimize the losses. Losses are particularly high at ports, especially if hooks are used to handle the bags. J.J. Schultz and W.E. Clayton (1981) cite a case in West Africa, on an occasion when there were insufficient trucks to remove the fertilizer, a loss of 5 to 10% of bagged fertilizer occurred at the port alone, due to the use of hooks, reckless operation of the fork-lift and crane, no attempt to clear up spillage, etc.

5.4 The reduction of fertilizer losses

Good practices for the reduction of losses are given at the end of this section, respectively concerning the reduction of losses of fertilizers in bags and during the shipment of bulk fertilizers. These tables show that fertilizer losses can often be reduced by simple measures and improved training, at a cost which is a very small proportion of the value of the fertilizer lost. The following factors are very relevant in this context:

Awareness

The lack of awareness of the importance of fertilizer losses cannot be over-emphasized. The extent of fertilizer losses in individual countries needs to be assessed more objectively and then related to losses in terms of money, foreign exchange and food in order to demonstrate the damage to the national economy. The subject of fertilizer losses should be included systematically in marketing and distribution training programmes.

It has been observed that losses of food, even under very difficult conditions are less than those of fertilizers. The people handling them do not appreciate that the fertilizers can produce several times their weight in food. If fertilizers are heavily subsidized this too tends to diminish the value attached to them. It is therefore important to educate the people involved in the handling of fertilizers, concerning their value.

Training

Training is necessary at all levels of responsibility; port workers, supervisors, warehouse staff, managers, dealers, fields sales personnel, advisers, farmers. Such training is likely to repay manifold the time and money invested. It is recommended that a sufficient proportion of the total amount allocated to physical facilities and sales costs should be devoted to training. The training may be given by the national organizations and international agencies, fertilizer companies and consultants. Preferably all of them.

Proposals concerning a training program and the people to be trained, made by T. Byrd and S.K. Reddy (1982) are:

Key personnel to be trained:

- Personnel involved in import (including dock workers) and transport activities.
- Storage personnel.
- Sales personnel (including retailers and advisers).
- Farmers.

(Perhaps the fertilizer retailer should be added to this list).

The techniques and methods used should be adapted to the type of trainee.

Content of the training programmes:

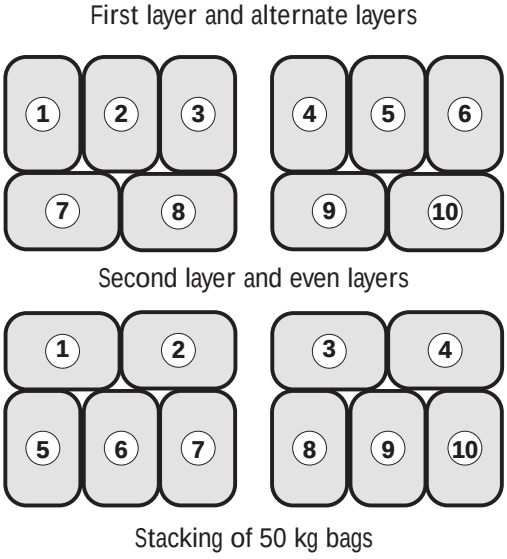
- Create awareness of the importance of fertilizer losses.
- Suggest simple and inexpensive measures and techniques to prevent and minimize losses.
- Provide promotion and instruction material, which should include assessments of the losses in financial and food terms.

Motivation

Distribution margins must be adequate. It is sometimes not realized by public authorities that the retail margin is not all profit. It has to pay for the return on investment in the facilities (e.g. storage and handling), the risk, labour, services and management. In many countries, the margin permitted to the distributor is insufficient. He cannot invest in suitable storage facilities, and has little reason to put much effort into the distribution of fertilizers. In Bangladesh, with liberalization of fertilizer dealing, better incentives to dealers, consolidation of distribution points, a dealer training program, etc., losses were reduced from 7% to 2%.

Annex 1: The stacking of fertilizer bags

The height of a stack of bags should not exceed 10 to 13 layers and the bags should be placed on each other alternating the direction of their longest dimension, as is in the following figure:



Stacking of 50 kg bags

Allow plenty of space around the stacks. Have separate stacks for different types of fertilizer.

Annex 2: Loss reduction rules for fertilizers in bags[1]

Type of Loss	Cause of Loss	Reason	Remedies
1. Spillage	a. Torn bags	Using hooks during off-loading at quayside	Introduction of mechanical equipment Using special grips Paying incentives to demurrage gangs for not using hooks
		Using too thin and sharp slings during off-loading of vessel	Introduction of loading nets Broad slings Palettization
		Usage of faulty transport and handling equipment (protruding nails, splinters, sharp edges, etc.), as well as unsuitable supercargo	Check all equipment and correct accordingly Train staff in charge to detect and report such faults Prohibit supercargo
		Uneven storage floor surfaces, sharp corners, damage to bags inflicted by careless manoeuvring with handling equipment	Improve storage conditions Train storage and handling staff
	b. Burst bags	Dropping of bags from excessive height	Use appropriate handling equipment Train handling staff
		Excessive pressure due to over-high stacking	Provide adequate storage Train store men in adequate storage techniques
		Faulty bags	Return bags to supplier for analysis and eventual refund
	c. Decomposed bags	Excessive storage without due protection against weathering	Provide adequate storage facilities Improve requirement forecasting and ordering to reduce storage period
		Direct contact with moist floor	Provide dunnage for storage facilities including open air storage
		Lack of ultra violet stabilization for consignments to tropical countries with long open air storage periods	Specify ultra violet stabilization when ordering
	d. Split seams	Pulling of bags at one corner, dumping from excessive heights, etc.	Train handling staff and improve supervision Purchase of modern handling equipment
		Faulty closure (twine too thin, heat seal not adequate	Return bags to supplier for analysis and eventual refund
2. Damage	a. Moisture penetration through holes in bags (caking)	Torn bags, burst bags, decomposed bags and split seams	Any of the above as applicable
	b. Other chemical changes	Excessive storage period under inadequate conditions	Improve sales-forecasting and ordering to reduce storage period Improve storage facilities
3. Theft		Lack of security measures in transit and storage	Improve control and record-keeping system Check security measures and improve safety facilities

[1] *FAO/FIAC Working Party on Fertilizer Marketing and Credit (1982)*

Annex 3: Loss reduction rules for bulk fertilizers

It is of vital importance that fertilizers in bulk are protected against humidity of all kinds, to keep them free from lumps and free-flowing. If this is not done, large quantities will certainly be destroyed, causing difficulties both for oneself in handling and also for those who will later have to spread the fertilizer on the fields.

Bulk material must not be discharged while it is raining. When unloading into trucks or rail wagons, the loading area must be clean and dry. Look out for remaining grain.

The floor of the warehouse must be asphalt, or better, concrete. It must be of such a nature that humidity cannot penetrate from the ground. New concrete structures should be cast using "Corrocem" inhibition to make the concrete resistant to chemical aggression.

All untreated concrete areas which come into contact with the fertilizer must be treated with an impregnation preparation. This is to protect the concrete when the fertilizer is stored as bulk for a long time. For short-term exposure, 1-2 weeks, this is not specially required. Such impregnation will make it easier to keep the warehouse clean and prevent the formation of lumps due to changes of the humidity in the concrete.

If a conveyor with a tripper, or something similar, is used for storing material in a bulk store, it should be moved so that the material is spread fairly uniformly to avoid granule size separation. If this is not done, it will be observed that the small granules will be concentrated at the top of the pile or along the crest of the pile, whereas the large granules will be concentrated at the foot of the pile. Separation or segregation, as this effect is called, may result in noticeable variation in rates of application and spreading width when the material is spread on the fields.

As soon as possible and not later than one day after the material has been stored, it must be covered with plastic sheeting. This should be 0.10-0.15 mm thick and preferably 6 m wide. The joints must overlap by about 0.5 mm.

In order to avoid unnecessary air circulation doors and other openings must be kept shut as far as possible.

The floor and driveways in the warehouse must be kept free of fertilizers. Moisture and dissolved fertilizers are best removed with dry sawdust.

When removing material from the warehouse, no more than necessary of the plastic sheet must be removed. The bulk material must be covered again immediately after the work has been finished.

If material is moved by payloader, the driver must be instructed that:

a. the shovel must be shaken immediately after each loading;

b. the wheels must not be driven into the material as this will crush the material to dust.

Urea especially has a tendency to cake during storage, and urea and also other grades should therefore be screened before they are bagged. Screening should also be done in the case of bulk supply to farms. At times the lumps may amount to a considerable percentage of the total material. It is therefore important that the screening surface is made sufficiently wide and long, as many lumps will be broken by passing over the screen. This partial flow may attain as much as 5-10 percent of the main flow. A sieve aperture of 8 x 15 mm is recommended.

6. Environment

6.1 Codes of practice

A number of codes of practice relevant to the distribution of mineral fertilizers have been issued.

For example, the Fertiliser Manufacturers' Association in the U.K. has issued recommendations for the prevention of water pollution from storage and handling of a) solid fertilizers and b) fluid fertilizers. Extracts from the solid fertilizer code are given in the annex to this chapter.

In the solid fertilizer code, special reference is made to ammonium nitrate. Ammonium nitrate fertilizers are not themselves combustible, but as they are oxidizing agents they can assist other materials to burn, even if air is excluded. If involved in a fire, they may melt and decompose with the release of toxic fumes. Under the impact experienced in normal handling, ammonium nitrate fertilizer will not explode but there is a risk of explosion if it is allowed to heat up in a confined space e.g. in drains, pipes, plant or machinery particularly if it becomes contaminated. Any site which contains or is likely to contain more than 25 tonnes of ammonium nitrate must be reported to the Local Fire Authority and the Local Office of the Health and Safety Executive (HSE). A warning sign must be posted at the site entrance as required by the Dangerous Substances (Notification and Marking of Sites) Regulations 1990. Any site which contains or is likely to contain more than 350 tonnes of ammonium nitrate fertilizer requires the operator to be able to demonstrate safe operation. For any site with more than 2500 tonnes the operator is required to submit a 'Safety Report' and 'Emergency Plans' to the Health & Safety Executive. Reference may be made to the *FMA Handbook on the Safe Storage of Ammonium Nitrate-Based Fertilizers.*

(In some countries such as Germany, Finland and the Netherlands, the maximum quantity of ammonium nitrate which can be stored in individual heaps is below 100 tonnes. This makes the marketing of straight ammonium nitrate fertilizer commercially non-viable in those countries).

In the FMA fluid fertilizer code detailed guidelines are given, but attention is drawn to six main points:

- Fixed or mobile stores must be sited with care.
- Any spillage which occurs must be properly dealt with to avoid pollution.
- Stores, valves and pipework must be properly maintained and inspected and records kept.
- Field tankers must have their hatches/lids securely closed before being moved.
- Valves must be secured so that they can only be opened by authorized personnel.
- Have a spillage contingency plan. Know what to do in an emergency.

Fluid Fertilizers can be applied to the field very accurately, thereby avoiding unwanted and potentially damaging applications to hedge bottoms or ditches. As with all nutrient sources including solid fertilizers and organic manures and wastes, care must be taken with their storage, transfer and transportation. A major spill of fluid fertilizers can be much more harmful environmentally than some broken bags.

To take another example, The Fertilizer Institute, TFI, in the USA has issued an *Inland Barge Survey Procedures Manual, Fall 1997*.

There are chapters on:

- Terminology and Definitions
- Conditions of the Barge Survey
- Field Measurement Procedures

- Calculation Procedures
- Report Formats
- Safety.

Codes of practice are prepared to help prevent the illegal use of fertilizer products. The illegal and improper use of fertilizers is a particular concern of the fertilizer industry. Detailed guidelines were issued on the safe storage of ammonium nitrate following the April 1995 Oklahoma bombing incident.

The ARA (Agricultural Retailers Association) and TFI have issued a brochure entitled *Deter Theft of Anhydrous Ammonia* use with farm customers, employees and the general public. The stolen anhydrous ammonia may be used for making a powerful, illegal narcotic called methamphetamine.

In the United States substantial quantities of anhydrous ammonia are applied directly in the field. Anhydrous ammonia is a compressed gas under relatively high pressures and many safety features must be included in the equipment. Ammonia is not poisonous but it can have drastic adverse effects on human tissues that come into contact with liquid ammonia. Safety precautions, clothing and practices must be strictly observed. One simple recipe for making methamphetamine, readily available on the Internet, requires several commonly available precursors, including anhydrous ammonia.

6.2 Toxic impurities

Cadmium

To date, with the exception of limitations to the content of cadmium (Cd) in phosphate fertilizers in some of the smaller fertilizer markets of West Europe, the impurities present in mineral fertilizers have not been regarded as posing a particular risk and, with the exception of one or two countries, such as Canada and recently Australia, their content has not been regulated.

The cadmium in phosphate fertilizers, on the other hand, has received a great deal of attention, partly due to the fact that cadmium is the subject of one of OECD's "Risk Reduction Monographs". Several OECD countries, albeit among the smaller users of mineral fertilizers, have regulated the maximum amount of cadmium allowed in phosphate fertilizers. The Scandinavian countries, and Switzerland have imposed low legal limits. To comply with these levels, the products must be manufactured from phosphate rock or intermediates with a low Cd concentration. These countries, however, account for less than 1% of world consumption. In view of the limited global availability of low-cadmium phosphate rock, comparable limits in major phosphate consuming countries would have had serious economic consequences, on both agriculture and on the economies of some of the phosphate-producing countries, out of proportion to the immediate risk. Nevertheless, the problem has been recognized by the fertilizer industry and, as indicated above, longer term effective solutions are being sought.

Austria, Belgium, Canada and Finland have regulated the total permissible input of Cd into agricultural land from fertilizers, sludge and other materials.

All state governments of Australia have legislated or drafted amended fertilizer regulations and all of these contain limits as to the level of cadmium allowable in fertilizers. Some are more stringent than others. All will require the level of cadmium and certain other toxic elements to be clearly stated on the fertilizer bag or advice note and some include a requirement for warning labels to be included for Cd, Hg and Pb to the effect that continued use may result in soil contamination and produce exceeding the Minimum Permissible Content, MPC. Regulations have been introduced in the States of Victoria and Tasmania which require the maximum cadmium, lead and mercury contents of fertilizers to be declared on the product's package or label.

In addition, a warning statement is required where the concentration of cadmium, lead or mercury in the fertilizer exceeds that typically

present in agricultural soils. These levels have been set at:

- 1 mg cadmium/kg product,
- 20 mg lead/kg product,
- 5 mg mercury/kg product.

The Fertilizer Industry Federation of Australia, FIFA, has prepared a training kit to assist in raising the awareness of fertilizer dealers and their staff to the implications of the presence of these impurities in fertilizer products and the factors they need to take into account when giving advice on fertilizer use.

In the case of cadmium, it is not simply a question of how much cadmium is applied to the soil, which is sometimes a small proportion of the naturally-existing cadmium, but how much is taken up by the crop. An example of the effort to limit the cadmium level in food, is the recent issue of an extension brochure which outlines management practices to minimize the uptake of cadmium by potatoes by the Cooperative Research Centre for Soil & Land Management and the CSIRO Division of Soils. The strategies vary but may include:

- using irrigation water with lower chloride levels,
- choosing varieties that take up less cadmium,
- liming,
- adding zinc enriched fertilizer at planting,
- changing to lower cadmium content fertilizer,
- reducing phosphorus fertilizer rates (if soil phosphorus levels are adequate).

Radioactive elements

Potassium and phosphate rock contain small, naturally occurring amounts of radionuclides. In the EU, a 1996 Directive stipulates limits for the handling and storage of such materials, which include fertilizers. There is no risk to the general public but it is advisable to supervise worker exposure conditions in large bulk storage facilities.

6.3 Waste disposal

Within the European Union the management of waste is considered to be a key task. Production of waste is on an upward trend and thus measures are aimed at prevention, recycling and the development of an infra-structure for safe disposal.

In many countries fertilizers are distributed in packages rather than in bulk. Plastic sacks made from polyethylene or polypropylene are most commonly used because of the need to maintain the quality of the fertilizer. These bags range in size from 25 kg up to Intermediate Bulk Containers of 500 kg or 1 tonne capacity. Paper and/or hessian sacks can be used but are not suitable for nitrate containing fertilizers.

Used fertilizer sacks can be re-used for many purposes at the farm level but in due time a surplus is likely to accumulate. Legislation requiring the establishment of plastic recycling schemes has been introduced in some countries (for example Germany). In other countries (for example UK) voluntary recycling schemes involving both the producers and the users (fertilizer producers) of the plastic sacks have been introduced.

In the UK, suppliers responsible for handling more than 50 tonnes of packaging per year have a recovery obligation under the provisions of the Producer Responsibility Regulations 1997. Farmers are excluded from this requirement, but should ensure that all waste packaging is legally disposed of and not burnt. Use should be made of plastics recovery schemes whenever possible or commercial waste disposal.

6.4 Safety

The European Community has implemented a Directive (91/115 EEC) which requires the issue of Product Safety Data Sheets. These sheets serve two purposes. They inform those concerned in handling chemicals of the hazards involved and they also provide the basis for risk assessments.

Safety data sheets must be provided at all stages in the distribution chain. The Directive sets out in detail the safety information to be given and the way in which it must be set out. To help fertilizer manufacturers some national and international organizations have prepared general data sheets so that the information given for particular fertilizers and intermediates is consistent. For example, the Fertiliser Manufacturers' Association in the UK has prepared a series of safety data sheets for ten different fertilizers.

The European Fertilizer Manufacturers' Association (EFMA) has issued a publication entitled *Guidance for the Compilation of Safety Data Sheets for Fertilizer Materials*, 1996, which provides model safety data sheets and guidance for:

- Ammonium, anhydrous
- Ammonia, solution
- Ammonium nitrate fertilizer
- Ammonium nitrate solution
- Ammonium sulphate
- Calcium ammonium nitrate
- Diammonium phosphate (DAP)
- Monoammonium phosphate (MAP)
- Nitric acid
- NPK fertilizer (ammonium nitrate based)
- Phosphoric acid
- Sulphuric acid
- Urea.

6.5 Fire

In most industrialized countries very strict regulations must be complied with in the event of fire in a fertilizer store. Typical regulations for the storage of ammonium nitrate are referred to in section 6.1. above.

The above-mentioned EFMA safety data sheets included instructions on fire-fighting measures to be taken if fertilizer is involved in a fire. For example, breathing the fumes should be avoided. In general, if water containing fertilizers enters drains or watercourses, the local authorities should be informed immediately. Molten fertilizer should not be allowed to run into drains. Especially in the case of ammonium nitrate and compound fertilizers containing ammonium nitrate, contamination by oils or other combustive materials should be avoided. Etc.

6.6 Environmental compliance

The following text is taken from J.J. Shultz and D.W. Rutland *Impact of Environmental Legislation on the Supply and Cost of Fertilizer*, presented at The Fertilizer Institute's World Fertilizer Conference, September 1992.

Approximately 13000 retail outlets serve the nation's approximately 2.2. million farmers. Nearly 5000 of these retail outlets operate dry fertilizer blending and/or fluid fertilizer mixing facilities. These 5000 facilities have fertilizer raw material and product storage capacity equivalent to about 46% of their combined total annual sales.

From these figures, it is clearly seen that the small, and often resource-poor, fertilizer retailers, because of the large amount of storage capacity they manage and control collectively have a major impact on the performance and costs incurred by the basic production units. If the economic viability of a significant number of these retailers is threatened by restrictive and costly environmental compliance, the impact will be quickly felt not only by the basic producers but by the farmer customers as well.

The economic impact has been estimated of environmentally driven storage and handling regulations recently enacted in the State of Indiana (U.S.A) affecting fertilizer and pesticide retailers. The regulations pertain principally to the management and containment of fertilizer and pesticide discharges from the retailers premises. These estimates indicate that the incremental cost of environmental compliance may add the equivalent of US$ 2.0 to US$ 3.6 to the cost of each short ton of product sold if all costs are charged only to the fertilizer component of the retailers business. The lower value

is based on annual fertilizer sales volume of 9,000 short tons, and the higher value is based on an annual sales volume of 3,000 short tons. Additionally, the incremental capital investment required to achieve the desired level of compliance was estimated at about US$ 45,000 for the small (3,000 stpy) facility and about US$ 79,000 for the large (9,000 stpy) facility. This additional investment amounts to a 63%-67% increase over the retailers current base investment (excluding land, delivery and field application equipment, and working capital).

These estimates illustrate the magnitude of the additional investments that would be incurred by a large number of retailers in order to meet new environmental regulations. In the State of Indiana (U.S.A.) alone, about 425 fertilizer retailers are affected by the newly enacted regulations. The total number of fertilizer dealers in the United States engaged in some type of fertilizer processing (fluid mixing and/or dry blending) that would be affected by such regulations is about 5,000. It is quite likely that many other key agricultural states either have, or will soon have, in place legislation similar to that of the State of Indiana.

The following text is extracted from a paper presented six years later at the meeting of the Fertilizer Industry Roundtable, Maryland, October 1998. The paper is entitled *Environmental Compliance at the Retail Fertilizer Outlet*, by Michael R. Kenna, IMC Agribusiness, USA.

As recently as ten years ago full scale environmental compliance was something that, for the most part, was only found in large international corporations such as Dupont, General Motors and IBM. Although many of the environmental regulations that the fertilizer industry is faced with today were in effect ten years ago, it was unusual if not impossible to find even mid-size and larger retail fertilizer organizations that had corporate environmental policies. Part of this phenomena is because historically agriculture has been largely exempt from certain Federal regulations, primarily those related to the environment and transportation. Today, environmental compliance is a fact of life for the long term survival and growth of any viable business. Lines between the traditional roles of health and safety, environmental, industrial hygiene and transportation are often blurred. Environmental managers are no longer expected to focus on environmental issues alone. Specific tasks and duties are now more related to overall risk management and incorporated into "Management Systems". Environmental, Health and Safety (EHS) professionals no longer work as separate entities attempting to guide top management of companies through the compliance maze. Instead, progressive corporations involve all personnel in integrated risk management systems to ensure compliance, while achieving sustainable growth in today's rapidly changing business culture. For example, the IMC AgriBusiness Environmental, Health and Safety (EHS) staff includes professionals that not only handle EHS issues, but also insurance, workers compensation, liability claims, department of transportation issues, technical services, engineering and construction activities. The (EHS) department at IMC AgriBusiness has grown from five persons in 1988 to a current staff of 31 full time employees.

A quick look at the volume of environmental regulations from Washington D. C. will paint a picture of the job at hand. United States Environmental Protection Agency (EPA) regulations, found in Title 40 of the Code of Federal Regulations (40CFR), consist of fifteen volumes with approximately 17,000 pages of text. There are over thirty separate environmental compliance subjects that directly affect the fertilizer industry. In comparison, the Department of Labor regulations under the Occupational Safety and Health Administration (OSHA) 29CFR, and the Federal Motor Carrier regulations under the Department of Transportation (DOT) 49CFR are contained in about three volumes with approximately 2800 pages of text.

Several things complicate all of these regulations and make compliance even more difficult. Many of the agencies have regulations that address the same issues as other agencies, but the compliance requirements are not comparable. For example, terms relating to hazardous chemicals such as flammable,

toxic and even hazardous may be defined and interpreted very differently by the EPA, OSHA and the DOT. There are examples where corporations are caught in the classic regulatory Catch-22 where separate governmental agency regulations concerning the same issue are contradictory. Finally, regulations are not static but constantly in flux with changes appearing in the Federal Register every day. It is no wonder that smaller retail companies and the so called "Mom and Pop" stores operate on the fringe of compliance, and more often than not are unaware of the regulations. Certainly it can be argued that this regulatory pressure, among other key factors, is playing a part in the overall consolidation that is occurring in the industry.

For those that have seen the future of the retail fertilizer business, and have the vision to plan for growth in the midst of these regulatory obstacles, Integrated Risk Management systems are as necessary as sales, production, accounting, credit and information systems.

(Here Mr. Kenna gives some practical examples).

These are a few examples of federal and state regulations that can have significant financial impact on the retail fertilizer industry. Compliance with these regulations, although burdensome, can be achieved with a coordinated effort and corporate commitment. The cost of compliance is not always associated with highly technical equipment or costly capital expenditures. Often individual decisions and daily routine practices can have the greatest positive impact. An integrated approach to regulatory compliance achieves the desired goal, with the added benefits of improved performance and operating efficiencies.

6.7 Community relations

An article which appeared in the Agricultural Retailer, (USA), April 1999, dealt with the problems retailers in the USA face with the public release, in mid-1999, of government-mandated Risk Management Plans (RMP), involving increased public scrutiny of retailers' facilities.

In this article, Mike Neal reported that his company, *IMC AgriBusiness, wants to make sure that company's retailers are well prepared to answer tough questions and to turn this situation into a long-term opportunity. It was feared that some retailers may not have the public relations skills or understand RMPs well enough to answer questions quickly and correctly. Neal stated that all retailers need to understand the key elements of RMPs and the related community relations aspects. Hence, his company is organizing training sessions for IMC retailers nationwide. The sessions will bring retailers up to date on the regulation and make them a little more comfortable talking to the public.*

Priority locations are in areas with higher populations and where the surrounding public is non-agricultural. For example, they may be on the edge of a metropolitan area where people are not familiar with the agricultural business and certainly not with anhydrous ammonia. But dealerships adjacent to urban areas are not the only ones that need to be prepared for heightened public awareness of their facilities. In a small community, people will not call senior management at the corporate level. They will ask the people in their community.

The RMPs will be made publicly available on the Internet. Media and other activist groups may demand to see the off-site consequence analysis under the Freedom of Information Act. Media will probably be the first to approach retailers about RMP information. Then, after the information gets out, people close to the facility and some customers will start asking questions. If they answer with incorrect information or delay the response, people will find other sources, which may not represent the retailer's best interest.

The US Agricultural Retailers' Association, ARA, has produced a tip-sheet for its members about how to handle community relations surrounding RMPs. It will provide tips and information that retailers can immediately put to use in their organization before the RMP

information is publicly released. And it will explain how retailers can maintain good community relations.

By talking to key groups of people, such as elected officials, key business people and the local school board, before the RMP's are publicly released, retailers gain two benefits. First, retailers can familiarize community leaders with their operations, explaining how they train repeatedly and what safety programs they have in place. Second, they can provide a source for answers, ensuring retailers will be called on for information, instead of other sources who may not have accurate information. By identifying and communicating with the key groups, retailers can lay the groundwork for long-term relationships.

Annex

Extract from the *Code of Practice for the prevention of water pollution from storage and handling of solid fertilizers*, Fertiliser Manufacturers' Association, FMA, U.K., May 1998.

The code concerns solid fertilizer storage facilities at manufacturers premises, merchant stores, port authority stores and farm stores.

- The suitable location of fertilizer stores and storage sites, including uncovered storage areas is critical to reducing the risk of potential contamination of watercourses or groundwater in the event of a spillage or other incident. It should not be assumed that existing sites, including plants, stores and storage areas are correctly sited, even if no pollution incident has arisen. Ideally, no site should extend to within 10 metres of a watercourse. This requirement should certainly apply to new sites.
- Existing sites and preferably all new sites should be in areas where groundwater vulnerability is low and not in highly sensitive areas. Sensitive areas are in the proximity of boreholes, wells, springs, aquifer outcrops, soakaways, swallow holes, quarries or within 50 metres of abstraction for potable supply.
- Consideration should be given as to where any spilled fertilizer, firewater and/or general yard-washings and run-off would flow in the event of a spillage or other incident, including vandalism. Avoid locating sites near drains, channels and pits where molten ammonium nitrate from a fire could become confined.
- Fertilizer stores and storage areas should be sited away from public access to minimize the risk of interference or vandalism. Sites should be made as secure as feasible, with consideration given to 'intruder deterrent' lighting and fencing.
- Good, well-constructed, vehicular access for large delivery and emergency vehicles is essential.
- Sites for outdoor storage should be level and free from protruding stones. They should not be liable to flooding.
- The area surrounding any site must be protected from potential pollution. Containment is desirable in all areas where watercourses and groundwater are vulnerable. Pollution is most likely to be caused by spilled fertilizer being washed away by rainwater or from firewater used to control a fire at the site.
- Locate storage areas away from sources of heat or fire to minimize the risks of a fire involving fertilizer.
- An inventory of all fertilizer stored should be readily available in the event of fire.
- The store should be kept clean at all times and inspected regularly and particularly when maintenance is being carried out.
- It is recommended that all floor and ground surfaces should be level and free from sharp objects which might tear or puncture bags. Rats and other rodents should be controlled to avoid damage to bags.
- All bags should be handled with care to avoid damage. Pipes should be fitted over sharp edged tines on fork-lift trucks to avoid damage to the lifting loops. Damaged bags should be placed immediately into secondary bags to prevent further spillage.
- Intermediate bulk containers (IBCs) should be stored in stable stacks (avoiding excessive height), according to the *Recommendations for Handling Flexible IBCs*, published by the Flexible IBC Association. IBC stacks should be positioned so that the base of the stack remains dry.
- 50 kg bags should preferably be stored on pallets to allow rapid relocation if necessary.
- Ensure regular inspection and maintenance of electrical equipment and fittings.
- All products stored outside for prolonged periods should be protected using shrink wrapping, covers or tarpaulins.

- Spillages and sweepings should be cleared up promptly and disposed of in slurry pits or spread thinly on growing crops or grassland. On no account should spillages be hosed away or allowed to enter directly into surface drains or watercourses or to gradually wash into soil.
- Manufacturers and suppliers should ensure that all employees and subcontractors involved in the storage, sale, distribution and application of fertilizers are adequately informed of the risks and the appropriate procedures designed to avoid the pollution of watercourses and groundwater. All employees and subcontractors should be adequately informed about the appropriate action to take in the event of a fire involving fertilizers with a high ammonium nitrate content.
- Manufacturers and suppliers should provide advice and assistance to their customers and contractors to encourage an awareness of the importance of careful storage, handling and use of fertilizers to prevent pollution. Attention is drawn to obligations under the Consumer Protection Act 1987, to provide customers with Product Safety Data Sheets.

In particular concerning ammonium nitrate - but the same standards may be applied to all fertilizers:

- Fertilizer sweepings (particularly of ammonium nitrate fertilizer) should not be allowed to become contaminated with combustible materials. Sawdust should not be used as an absorbent to clean floors.
- Ammonium nitrate fertilizers should be stored in a single storey, well ventilated building constructed from materials that will not burn, such as concrete, bricks or steel. The store should be cleaned both before deliveries of fertilizer are taken in and before any other materials are to be stored in the building.
- To prevent contamination and avoid risk of fire, ammonium nitrate fertilizers should be stored away from incompatible materials such as farm chemicals, oil and grease and combustible materials such as wood and straw. Storage near gas pipelines should also be avoided.
- Ammonium Nitrate Fertilizers, stored outside, should be protected from extreme temperature changes which can cause product degradation.
- Ammonium nitrate should not be stored in bulk other than at the site of manufacture. In the UK, the Fertilizers Regulations 1991 require that all Ammonium Nitrate Fertilizers supplied to farmers must be in packaged form.
- The Carriage of Dangerous Goods by Road Regulations 1996 specify that vehicles used to transport 500 kgs or more of ammonium nitrate fertilizer carry the appropriate warning placards, fire extinguishers and written hazard information.
- The Carriage of Dangerous Goods by Road (Driver Training) Regulations 1996 require the driver of a vehicle carrying ammonium nitrate fertilizers on a vehicle having a permissible maximum weight exceeding 3.5 tonnes, to hold a vocational training certificate.
- Partial exemption from the requirements is allowed where not more than 10 tonnes of fertilizer is being moved between pieces of land occupied for agricultural purposes, within a radius of 12 km, in an agricultural vehicle.

7. Quality and services

7.1 The importance of fertilizer quality

The influence of the quality of the fertilizer granule on the evenness of application of the nutrients is well documented. The optimum rates of fertilizer nutrient application required by different crops/soils have been established by innumerable field trials throughout the world and the importance of respecting these rates by the even distribution of the nutrients is evident.

A good quality, solid fertilizer has a low dust content, a consistent bulk density for each type of fertilizer, consistent particle size distribution, maintenance of quality during long term storage and consistency of quality at every purchase. It is free flowing, free from excess moisture and the granule resists breakdown. Blends need to have a balanced and even particle size spectrum, combined with adequate grain hardness and resistance to abrasion. The production of granular rather than prilled fertilizers has also been accelerated by the development of blending. The requirement for good quality granular or large prilled material has increased. The potash industry continues to invest in compaction capacity.

The quality of fertilizers is likely to become increasingly important as fertilizer use legislation is implemented in different European countries. Farmers will seek the most efficient response from the nutrients they are permitted to apply.

7.2 Granule quality

The quality of the granule is important. The granule size should be homogenous. A 4 mm granule is 64 times heavier than a 1 mm granule of the same product, with an evident impact on its trajectory once it leaves the spinner - a fertilizer granule leaves the spinner disc at up to 90 kph. In Europe, where 90 to 95% of the fertilizer spreaders are of the centrifugal type, the influence of the quality of the granule on the evenness of distribution of the nutrients is well documented. Mixtures of different materials, of different particle size, shape, weight, density and surface texture, tend to segregate during handling and application. This can result in uneven field application, with a loss of crop which far outweighs the fertilizer cost saving.

The wider the spreading width of a fertilizer applicator, the more important is the quality of the fertilizer granule. In major arable areas, in France, for example, farmers are tending to use centrifugal spreaders with a wide spreading width (24 metres for example) in order to reduce their application costs.

Legislation covering fertilizer quality is normally restricted to the chemical composition. Physical characteristics such as particle size, storage quality etc., are normally governed by market forces and the local conditions.

The Fertiliser Manufacturers' Association (FMA) in the UK has developed and implemented the independently evaluated "SP Fertilizer Quality Mark" scheme for straight nitrogen fertilizers. It reflects the spreading qualities of the fertilizer.

7.3 Complex fertilizers

Complex fertilizers, with their nutrients chemically combined, with high quality, stable granules, and each nutrient of the guaranteed formula present in each granule, offer many advantages. Their quality is carefully controlled to industrial standards, which guarantees that their nutrient content is within the tolerance limits specified in relevant fertilizer regulations.

The granules are free-flowing, resistant to moisture and physical damage, easy to handle and can be applied evenly. The products are screened to ensure the granule size conforms to a tight specification. Anti-caking agents are applied, and the surface of the granules is often treated with a powdery substance to improve flowability. Secondary nutrients and micronutrients can be easily incorporated. Complex fertilizers also offer some protection against adulteration and fraud. A wide range of grades is available, to suit any agricultural situation.

Evidently, this quality has to be paid for and complex fertilizers are more expensive than blends of commodity materials. But the cost saved by purchasing a sub-standard product can easily be outweighed by the loss of yield and crop quality, under practical farm conditions. A 2-3% yield loss on most crops will more than outweigh any financial benefit from buying cheap, poor quality fertilizer. Work in the UK has demonstrated that the financial loss from the inaccurate spreading of poor quality fertilizers on grass can amount to half the fertilizer cost. Also, excess nutrients, especially nitrogen, not taken up by the crop, are likely to be lost to the environment. Uneven fertilization means over-fertilization (pollution) of some areas, under-fertilization (loss of yield/quality) of others.

In more remote regions, and particularly in land-locked countries of Africa, the cost of getting fertilizers to the farm are such that economies at the expense of the quality of the fertilizer purchased have only a small proportional impact on the farm-gate price, but can have a major impact on the efficiency of the product.

7.4 Bulk blends

A high quality bulk blend is of similar quality to a complex fertilizer, but there are many possibilities of it not reaching this quality. It is essential that the different components of a bulk blend should have similar physical characteristics, especially as regards the granules. The need for and application of trace elements is increasing and it is difficult or impossible to mix small amounts of trace elements evenly in the blended mix. The distribution on the field can range from zero to toxic levels. A partial solution is to coat the micronutrients onto one of the fertilizer ingredients. In the USA, the computer-controlled chemical impregnation of blends, for example with micro-nutrients, can be effected during application.

In West Europe at present there is no distinction between blended and complex fertilizers in the European fertilizer directives. The EC Directive on Sampling and Analysis gives no special precautions for blends and some modifications need to be made. In fact the control of the quality of blends is complicated by the difficulty of obtaining a representative sample. Considerably more samples are required, taken at random. Once suitable techniques have been introduced into regulations, it is reasonable to expect that good blends will give similar results to complex fertilizers and that bad blends will be shown to be deficient - their producers may have to over-formulate which would prove costly. Tighter control on the quality of blend can come from two directions - legislation and market forces. Codes of practice have been developed for the guidance of blenders and if these are followed the overall quality of blends should improve and then it will be purely market forces which decide the outcome.

Codes of practice for blends have been developed by the European Blenders Association, prepared by Graham E.N. Lance, entitled *Handbook of Solid Fertilizer Blending. Code of Good Practice for Quality.*

The following are some of the recommendations:

In order to produce blends of high quality it is necessary that the components should be:

- *chemically compatible,*
- *physically compatible,*
- *measured in precisely,*

and the resulting blend should be handled carefully in order to avoid segregation of the different components.

It is evidently necessary that the blend should conform with its guaranteed chemical composition. The components should be sampled and analyzed systematically on receipt. The Critical Relative Humidity of the different components is an important criterion in their choice, both alone and in admixture. In particular, mixtures of urea and ammonium nitrate should be avoided. For good storage, the relative humidity of the air should be below that of the components of the fertilizer. The components should be chemically compatible. Problems can be encountered with mixtures of:

- *urea and the superphosphates,*
- *ammonium phosphate and superphosphate.*

The granule size of the constituents should be carefully matched to reduce segregation. Various methods of measuring granule size and frequency are available. Base grades of binary and ternary fertilizers may be used. They can reduce the problem of segregation.

Other quality characteristics, such as apparent volumetric mass, flowability, the spherical properties, hardness, crushing strength, dust content, resistance to moisture uptake and resistance to caking should be taken into account. Various precautions can be taken to reduce segregation during handling.

The Fertilizer Institute in the USA has prepared revised guidelines for producing good bulk quality blends, focusing on the Size Guide Number (SGN) and the Uniformity Index (UI). Particle hardness is significant in the case of P_2O_5 fertilizers; products made from low impurity acids may be softer or less uniform. Fertilizer quality has also improved with the use of better coating agents.

The Fertilizer Institute in the USA also has produced a *Bulk Blend Quality Control Manual*, which covers:

- Selecting materials
- Computing formulas
- Plant design and equipment
- Plant operations and housekeeping
- Fertilizer plant safe operations
- Personnel responsibilities
- The sampling and physical test methods.

7.5 Advice and services

Product Stewardship

Rosemary O'Brien of CF Industries, CFI, USA, stated in a paper presented at the IFA Annual Conference, held in Toronto in May 1998: *The message is that all of us must create the future that we want. Otherwise we are going to have to resign ourselves to another generation of costly reactive management that hurts in every way possible, with the media, public perception of our products, with businesses, in dealings with our government, and of course it hurts the bottom line. We have to be the ones to frame a new environmentalism for the 21st Century. We can either take these activities as a threat and be victimized by them, or we can look at the economic opportunities and profit from them. We at CFI believe we have to test our products, find out what is in them, make sure we are the neighbour of choice, that our products are products of choice for our customers. We have to make sure that our products are safe and that we are following sound management practices and that we act as environmentally responsible as we can. It is a new way of business for CFI. Change is happening, it is happening fast and if we wake up to this change and take advantage of it, it will be a real opportunity.*

To improve the efficiency of fertilizer use is a major challenge. Inefficient fertilizer use not only increases their negative environmental impact unnecessarily, but also represents a waste of natural resources and a substantial economic loss. There is scope for improved products, but in most developing countries fertilizer use is so inefficient that the greatest medium-term gain could be had from improving the way in which currently available fertilizers are used. Many techniques for achieving this are known, but often they are not put into practice, due partly to inadequate communication to farmers of information on correct techniques, and partly due to a lack of motivation on their part to adopt them.

Producers

Some large fertilizer producers in the USA are investing substantially in the establishment of services to accompany their products.

Reported in "Farm Chemicals", May 1999, Al Giese of Cenex/Land O' Lakes, CLO, stated: *Farmers are looking increasingly for technology-based services (biotech crops, site-specific programs, weather systems), as well as for value packages rather than individual components - product bundling, co-selling, buying incentives, and crop/animal value enhancement. Responding to a transformed agricultural infrastructure will require equal parts of products, efficiency, people, and technology.*

CLO found that the most successful cooperatives did not spend a tremendous amount of time buying expensive technology or infrastructure. They simply identified a potential customer base for the services, developed a business and marketing plan, and implemented these plans. Much of the initial infrastructure to actually implement these processes was leased from others.

Dealers

The fertilizer retailer is in direct contact with the farmer and is well placed to give advice on the use of the products he sells. In France, for example, farmers receive approximately 70% of their advice from the distribution sector, especially the co-operatives. In order to give correct advice, the distributor must himself be well informed. Training programmes for fertilizer dealers are organized in many countries, and in three countries are least, there are now programmes to provide certification schemes for persons giving advice on fertilizer use to the farmer. These advisors are often personnel of the distribution organizations.

In the USA, the introduction of new crop varieties into which pest resistance and herbicide tolerance have been introduced by biotechnological techniques has reduced the cost of crop protection inputs at the grower level by 30% for soybeans. Retail and distribution businesses have already seen a 10-15% drop in crop protection product sales with little reduction in overhead or other expenses. To compensate for this shortfall, input distributors and dealers are looking for new, revenue generating products and services to offer customers.

Information Technology

Today, approximately 40% of the farms in the United States and 70% of dealers are connected to the Internet. Forty percent of the on-line farmers have purchased products on the Internet. Dealers are beginning to help farmers to execute and fulfill production contracts. They are investing in information management systems. The change in demand for information and services offers significant new opportunities for distributors and retailers whose historical sources of revenue are decreasing due to adoption of the bio-engineered seeds.

US growers and dealers use the Internet for everything from quick price discovery to placing an order. They can even use an on-line auction service to anonymously dispose of products that they did not use for the highest price, and request the lowest bid for products they wish to buy. The Internet provides worldwide access for searching libraries and universities for knowledge. Farmers can get operating loans to purchase inputs and contract to sell crops using the system.

Advisor Qualification

It is now officially accepted in certain countries that individuals giving advice to the farmer should be appropriately qualified. In the U.K., the FACTS scheme has been established jointly between the FMA, the distribution sector and the Ministry of Agriculture, for the certification and training of farm advisers. In order to be registered the advisor has to pass an examination. In the USA and Canada, a Certified Crop Adviser (CCA) program has been established. It is administered by the American Society of Agronomy (ASA).

7.6 A case study on distribution-sector services offered by a fertilizer manufacturer

The Farmers' Service Programme of SPIC, India

Southern Petrochemical Industries Corporation (SPIC)'s fertilizer plant at Tuticorin in Tamilnadu, India, was commissioned in 1975 to manufacture nitrogenous and phosphatic fertilizers. Today, SPIC is one of the few fertilizer companies in India which markets all the three major nutrients, nitrogen, phosphorous and potash. SPIC also markets fertilizer grade ammonium chloride and various agro-chemicals, bio-fertilizers, botanicals and microbial-pesticides.

Besides marketing critical agri-inputs, SPIC has taken several steps to improve the living standards of the farming community. SPIC plays a key role in disseminating the latest scientific information on the efficient use of inputs in order to reap a good harvest and earn larger profits.

Programmes are 'tailor made', with a focus on technology transfer in agriculture, the need for balanced fertilizer application in order to encourage sustainable and environmentally friendly agriculture and the use of both organic and inorganic inputs in an integrated manner. The programmes can be grouped as follows:

- Agro Service Centres
- Farm Journal
- Farmers' Training Centre
- Input Diagnosis and Farm Advisory Cell.

Agro Service Centre (ASC)

The concept of establishing ASCs was established during 1987-88 with the prime objective of improving the socio-economic status of the farmers through improved agricultural practices and by intensifying allied activities utilizing the available infrastructural facilities.

The design of programmes is based on a bench mark survey conducted to assess the agricultural potentials such as crop intensity, input use pattern, agricultural machinery use and the economic status of farmers of the programme area. Each centre has 10 satellite villages as a core area within a radius of 10 to 15 km from the main centre, for ease of access and effective communication. The programmes are broadly classified as:

- Agricultural Development Programmes
- Rural Development Programmes
- Special projects specific to the area

Each Centre is managed by a qualified Technical Officer equipped to organize and conduct the schedule of programmes. The Technical Officers are guided and supervised by Development Officers positioned at the area level.

Necessary infrastructural facilities such as purpose designed buildings, tractors with accessories, agricultural implements and plant protection equipment are provided to the Centre for use by the farmers through the franchised agent, who maintains the facilities by collecting nominal charges. All agricultural inputs, such as seeds, fertilizers, agrochemicals, soil amendments are made available under one roof.

Programmes

Agricultural development programmes such as crop seminars, demonstrations, soil testing campaigns, seed treatment campaigns, animators' meetings and group discussions are conducted for the benefit of farmers. Rural development programmes such as animal husbandry campaigns, medical camps, eye and dental camps and general health care programmes are conducted in order to enhance the quality of life.

In association with M/s Oriental Insurance Company, SPIC has launched a special package insurance scheme called "SPIC Oriental Farmers' Insurance Scheme" (SOFIS) at very nominal premium rates, for the benefit of ASC farmers. Besides crops, agricultural pump-sets, cattle, housing, bullock-carts, personal accidents and agricultural inputs etc. are covered under this scheme. Each village will have a trained

Animator who will be the change agent for the farmers.

We have so far established 44 ASCs covering 440 satellite villages in the primary marketing territory. Several thousand farmers have benefited from this programme. The well-known "Training and Visit" (T&V) system is followed to disseminate the technology among the farmers.

Farm journal

In modern agriculture, keeping up-to-date with advanced scientific knowledge is very important for profitable farming. The crop production techniques developed at the research institutes should be communicated to the farmers through the right medium. Our farm journal " SPIC Farm News" has been doing exactly this for the farmers of the Southern peninsula. Through this platform, we propagate integrated farming with a special focus on the cultivation of high income crops. Reflecting the success of what must be a unique experiment, a large number of farmers have enrolled as subscribers to the journal in Tamilnadu and Andhra Pradesh. Every year, a "Face-to-Face" farmers' workshop is organized to propagate new agricultural themes highlighted in the Journal and the farmers are given an opportunity to have a meaningful interaction with relevant specialists/successful entrepreneurs. This acts as a spring-board for other enthusiastic young, dynamic farmers to launch new market-oriented ventures. We have played a catalytic role in organizing a successful vegetable growers' club, fruit growers' club and animal husbandry units for dairy, poultry, goat and fish farming.

SPIC Farmers' Training Centre

SPIC has established two Farmers' Training Centres, in Tamilnadu and Andhra Pradesh. The main objective of the training programme is to motivate and develop confidence in the minds of young, educated farmers to take up farming as a challenging profitable proposition. Emphasis is placed on teaching farmers to consider agriculture as a business enterprise and to view crop farming as a part of an integrated farming system.

The Centre is equipped with all amenities for training, including a model farm, with dairy, poultry, goat and pig units attached. Technical experts are drawn from the Agricultural and Veterinary Universities, Research Stations and other reputed institutions. Successful farmers and entrepreneurs share their experience with the trainee farmers. The training programme does not end at the Centre. Many of the farmers trained at the Centre have started business ventures such as fish farms, rabbit units, poultry farms and commercial vegetable cultivation. So far around 500 training programmes have been conducted for the benefit of 15000 farmers.

Post training follow-up

We keep in constant touch with the trained farmers through our field personnel and Agro Service Centres and give them necessary guidance on the technology adoption process. This has given very good dividends to the farmers and they have realized enhanced crop yields in paddy, groundnut, sugarcane and cotton ranging between 20% and 30%.

Input diagnosis & farm advisory cell

A modern Agricultural Input Diagnostic Laboratory was established at our headquarters, at Chennai, in 1994 with a facility to analyze the quality and suitability of the various inputs such as soil, seeds, fertilizer (both organic and inorganic), and water. The main services offered by the Centre are :

- Soil testing service for needy farmers, free of cost
- Diagnosis of soil, plant and irrigation water deficiencies and an advisory service
- Assessment of quality parameters of agricultural inputs such as seeds/ fertilizers and give them advice (other than legal advice)
- Organization of a Mobile Soil Testing programme for farmers
- Reclamation of alkali and acids soils to improve soil fertility
- Preparation of a soil fertility map and land use advisory service
- Farm consultancy for commercial farming.

SPIC's Farmer Service Programme, India

Cotton : a field demonstration.

A seed storage bin for a women farmer.

Teaching farmers to take soil sample.

Seed treatment for paddy, a demonstration.

Neem products for animal pest control.

At SPIC's eye camp.

8. Consumer protection legislation

8.1 An overview

As in all economic sectors, the consumer, in this case the farmer, must be protected by consumer legislation. Small farmers are particularly vulnerable to unscrupulous dealers and manufacturers. Farmers have no reliable means of testing the product and once it is applied to the soil it is too late to check for adulteration.

If the farmer is to know exactly what he is buying and whether the product is suitable for his needs, the information given on the bag and/or in an accompanying leaflet should include information on the identity of the product, the weight, the nature and composition, recommendations for storage, recommendations for use. There should be an efficient system for the control of fraud including adulteration, non-conformity with the label, under-weight and the presence of toxic substances.

Many countries, and all developed countries, have fertilizer legislation for the national market. Such legislation may take the form of a list of fertilizers which may be marketed, with details of composition and information to be provided at the time of sale. Alternatively it may require a registration or licensing process whereby manufacturers have to provide specified information to the relevant Government body, which will then approve or reject the product. With the latter system, there is usually an appeals procedure.

In most consumer protection legislation there is a requirement for the declaration of nutrient content. This means that the actual nutrient content supplied must be that stated on the documentation or label, within a defined tolerance. The tolerance may be a single negative tolerance, indicating an absolute minimum nutrient content, or it may be a plus and minus tolerance, thus giving a range of nutrient content. The tolerance is provided to allow for sampling and analytical error and to some extent, for manufacturing variability.

Approval to market fertilizers may be controlled by product registration and lists of approved products, (as in Denmark, Germany, India, the Philippines, the Republic of Korea), conformity with specifications as in the European Union and Japan, or “truth in labeling” as in the USA. In the USA individual state laws, amplified with administrative regulations, spell out procedures for registering products, licensing firms, information to be given on labels, etc.

For consumer protection legislation, the sampling and analysis methods are generally laid down or referred to in the regulations. For example, in the European Community, a Directive was first issued in 1977 setting out the sampling procedures and the chemical analysis methods to be used for EEC fertilizers. These and subsequent Directives are transcribed into the national regulations of each Member State, which may also contain additional methods required by the national legislation for non-EEC fertilizers. In the USA, the methods of analysis are those recommended by the Association of Official Agricultural Chemists, AOAC.

Fertilizer legislation and regulations are normally enacted in two stages:

- An Act, Law, Ordinance or Decree. These provide the legal basis for enforcement and analytical procedures, legal powers of entry for control officials, the institution of legal action, criminal or civil. These are basic principles which once established rarely require change.
- Regulations (Orders, Standards, Rules) made under the Act etc. by the national executive body, generally the relevant Government

department. These are relatively easy to modify as required. They contain detailed information on individual fertilizer products as well as technical instructions on matters such as sampling technique and analytical methods.

Fertilizer composition may be controlled by:

- Registration of approved individual products (e.g. Denmark, France).
- Specifications of products which may be marketed, including permitted tolerances on the declared nutrient contents (e.g. EU) - the "list principle".
- Conformity with what is stated on the label "truth in labeling" (e.g. USA).

8.2 Some examples

United States

The first workable inspection and control law was the Massachusetts Fertilizer Control Act of 26 May 1873. By 1902, 29 states had fertilizer laws and control laboratories. Most defined labeling requirements. State officials had the authority to take samples and there were severe penalties for violations.

Intentional frauds were largely eliminated. Usually, when a state adopted a law, the number of brands dropped dramatically but the tonnage was largely unaffected.

A major problem was the variability of results from the methods of analysis used. The Association of Official Agricultural Chemists was formed in 1884 to work out a solution. Once agreed, the methods of sampling and analysis became binding on the members. This Association, now known by its acronym, AOAC (International) still provides the official methods of analysis.

Fertilizers are state-regulated products. Forty-eight states have their own laws, amplified with administrative regulations, spelling out procedures for registering products, licensing firms, the information to be given on labels etc. Two states, Alaska and Hawaii, have no fertilizer laws.

Fines may be imposed by the state chemist, who may sample the product at any time. The fines can amount from one to three times the value of the product, depending on the state. The supplier can appeal, and then the dispute goes to court, but this is rare.

The Association of American Plant Food Control Officials, AAPFCO, has established guidelines for state fertilizer bills, fertilizer terms, definitions etc. It has also drafted a model "fertilizer bill", for the guidance of legislators in the different states of the U.S. The penalties include compensation to customers, cancellation of the license, seizure of product, prohibition of sale etc. with the possibility of court proceedings.

Hester (1996) described the nature and function of AAPFCO. It is an organization of fertilizer control officials from each state in the United States, who are actively engaged in the administration of fertilizer laws and regulations, as well as research workers employed by these states, who are engaged in investigations concerning mixed fertilizer materials and/or their component parts and also the effect of any of these

The Association's purpose is to achieve uniformity by consensus in providing a forum through which members may unite to:

1. Promote uniform and effective legislation - definitions, rulings, and enforcement practices;
2. Encourage and sponsor the adoption of the most effective and adequate sampling and analytical methods for fertilizer materials;
3. Promote accurate labeling of fertilizers;
4. Exchange information and discuss and co-operatively study issues confronting members of the Association and the industry;
5. Cooperate with members of the industry to promote the safe and effective use of fertilizers and the protection of soil and water resources.

European Union

Fertilizers are regulated at EU level by means of "Directives", which are binding on member states, but the countries themselves must implement them. The national legislatures transpose EU Directives into national laws.

A fundamental objective of the EU Fertilizer Directives is that fertilizers must contain the quantity and ratio of nutrients which have been declared. The regulations for EU fertilizers, i.e. determining which fertilizers may be sold throughout the EU, are based on the list principle. An original 1976 Directive, covering straight and compound nitrogen fertilizers, phosphate fertilizers and potash fertilizers, has subsequently been extended to cover secondary nutrients (calcium, magnesium, sodium and sulphur), trace elements, liquid fertilizers and some slow-release nitrogen products. See table 2. The legislation ensures the quality of the product, thereby protecting the consumer while encouraging free trade throughout the EU. Fertilizer types, nutrient contents and tolerance are, for example, covered by specifications.

Table 2. European Directives

Directive	Scope
76/116	Straight and compound NPK fertilizers
80/876	Ammonium nitrate fertilizers
88/183	Fluid fertilizers
89/284	Secondary nutrients (Na, S, Mg, Ca)
89/530	Trace elements (B, Cu etc.)
93/69	Additional ureaform fertilizers
96/28	Additional "dossier" fertilizers*

** The dossier scheme facilitates the addition of individual fertilizers to EU schedules. A dossier on a new product is submitted to the National Executive Body for onward transmission to Brussels. The dossier must contain information on health, environment and safety; agronomic data; methods of analysis. The procedure is described in EC notice 94/C 138/04.*

Consideration is being given to a further extension to cover organic and organo-mineral fertilizers.

In the case of straight ammonium nitrate, EU specifications are directed in particular towards product safety. Specifications which are relevant include granule or prill size, porosity, pH, organic matter content, chloride and copper contamination and detonability.

These directives include type designation, data on the method of production, minimum nutrient contents, and the nutrient contents to be declared (including forms and solubility).

Table 3. is an example extracted from Directive 76/116/EEC.

Separate Directives lay down specific procedures for sampling and the analytical methods used to check compliance. They are as described in table 4.

Table 4.

Directive	Scope
77/535	Sampling and methods of analysis
87/94	Sampling and analysis - AN
87/556	Sampling - fluid fertilizers
89/519	Methods of analysis - secondary nutrients
93/1	Methods of analysis - trace elements
95/8	Methods of analysis - trace elements

Products which conform with the specifications may be labeled "EU Fertilizers" and may be marketed in any EU country, provide they do not infringe national laws (e.g. on safety), and are labeled in the language of the country.

The following ISO standards also define fertilizer sampling procedures:

"Fertilizers-Sampling-Minimum mass of increment to be taken to be representative of the

Table 3.

total sampling unit". Technical Report 7553, July 1987.

"Solid Fertilizers and soil conditioners -test sieving". ISO 8397 February 1988.

National legislation covers product classification, packaging and labeling, product liability and consumer protection. Some specify the information which must be included on the bag to ensure that the user is provided with adequate information, while other legislation requires, in certain instances, that safety data sheets be provided. These provide information on product properties, health and ecotoxicological hazards. EU manufacturers have published a set of model data sheets covering 13 fertilizer materials and products. Individual companies base their own sheets on these in order to avoid any conflict in the data provided.

The situation in some individual EU countries is as follows:

Denmark (Brink, 1996)

The first Fertilizer (and Feedingstuff) Act in Denmark dates from 1898. Fertilizer control has been practiced by an independent body since 1962, but at a modest level, for the registration of products and control of the labeling. In order to comply with the EU directives, the Fertilizer Supervision Department of the Ministry of Agriculture was strengthened. Fertilizer control is now the responsibility of the Plant Directorate.

The designation "EU-Fertilizer" is not compulsory for marketing a fertilizer within Denmark. At present there are no definitions or standards for the physical quality of fertilizers.

Products are registered with the Plant Directorate. A "Fertilizer Catalogue" is issued once a year. Some 300 samples are taken annually, as described in Directive 77/535, using the methods of analysis prescribed in the Directive. All samples are analyzed for the main components.

The most frequent contraventions are differences between declaration and analytical content, omission of registration and non-legal statements on the label. A direct fine may be imposed or there may be prosecution in more serious cases. However, the results are published and this alone has a positive impact, leading to self-control.

A major problem is the long delay between sampling and the availability of the results of the analysis. It would be very expensive to build the laboratory capacity to shorten the time appreciably.

France

The application of mineral fertilizers in France began with phosphate fertilization in the 1840s. Soils in France were very deficient in phosphate at that time. It was difficult for the farmer to check the quality of the product and abuses soon occurred. An 1888 law concerned the repression of fraud in the fertilizer and soil amendment trade.

The 1888 law was passed at a time when crop yields were much lower than today, traction was by animals and there was a high level of recycling of nutrients on the farm. The main objective of the law was to control quality as regards the content of straight N, P and K fertilizers and Ca and Mg soil amendments.

A law of 1905, concerning the suppression of fraud, was also applicable to fertilizers. Fertilizers had to conform to the guarantees stated on the bag; if not, the offense of fraud was committed.

During the course of the 1900s, there has been enormous progress in agricultural techniques, with higher yields and hence greater nutrient removal, mechanization and lower nutrient recycling on the farm and much less restitution of organic matter. The regulations have been modified as new needs have become apparent; for example the law was modified in 1972 to cover micronutrients and organic amendments. Official methods of analysis for fertilizers were published in 1934. The methods of analysis have subsequently been were greatly refined by AFNOR (Association française de normalisation). In 1979, a new law was promulgated, concerning the "organization of the control of fertilizers and crop inputs". A "Comité, d'homologation des matières fertilisantes et supports de culture" of the Ministry of Agriculture, established by the law of 1979, is responsible for the registration of products.

According to the law of 1979, for a fertilizer to be imported or offered for sale in France, it must:

- either conform to the specifications given in the EU directives,
- or conform to standards which are already established, or registered for the most commonly used products,
- or otherwise be registered, if it does not fall within the scope of the above-mentioned categories.

It is the responsibility of the manufacturer/importer/dealer to demonstrate to the Administration, by means of documentary proof, that his product conforms with the regulations. He must also prove that the permitted tolerances are not utilized in a systematic manner. If the product does not comply, the law on the suppression of fraud is applicable. In all cases there must be proof of the effectiveness and harmlessness of the product.

The French standards currently in force are as follows:

NF U 42-001	and its supplements and modifications concerning fertilizers
NF U 42-002	(parts 1 and 2) and NF U 42-003 (parts 1 and 2) concerning fertilizers containing trace elements.
NF U 44-001	concerning calcic or magnesian amendments.
NF U 44-203	concerning mixed products based on calcium or magnesian amendments and fertilizers.
NF U 44-051	concerning organic amendments.
NF U 44-071	concerning mixed products based on organic amendments and fertilizers
NF U 44-551	concerning crop supports.

The texts of the regulations used for application of the law establish specifications for the composition of the products (forms and minimum content of nutrients), the labeling of packs and the controls to be carried out. The obligatory French standards and the European Union directives transcribed into French law are part of the regulatory texts.

The United Kingdom

In the United Kingdom, the original "Fertilizer and Feedingstuffs Act" dates from 1893. Developments in agriculture and in the nature of fertilizers required progressive expansion of the coverage of the Act and it was followed by new Acts in 1906, 1926 and 1970 (the Agriculture Act), and regulations have been issued on more than 20 different occasions since 1897. The latest were "The Fertilizers Regulations 1991", "The Fertilizers (Sampling and Analysis) Regulations 1991", "Planning (Hazardous Substances) Regulations 1992", "Fertilizers (Amendment) Regulations 1995" and "Carriage of Dangerous Goods by Road Regulations (1996)".

In the United Kingdom, an Act is the basic law, which provides a framework for subsequent regulations. The Act is passed by Parliament, after intensive discussion with all the parties concerned. Once the Act is promulgated, implementation by means of regulations is the responsibility of the relevant Ministry, normally the Ministry of Agriculture, Fisheries and Food. The Ministry is obliged to discuss proposed regulations with the persons or organizations likely to be affected.

Details are not specified in the Act, which is based on the expectation that, in courts, the judgment will be that of a "reasonable man".

The Agricultural Act of 1979 obliges manufacturers, importers or traders to comply with definitions of specific fertilizers laid down in the regulations. Rules for inspection, sampling and analysis are prescribed. Subsequent regulations concern aspects such as labeling, tolerances and packaging.

As regards penalties, in recent years there has been a move away from criminal prosecution towards administrative sanctions. This increases the chance of a successful prosecution because proof under civil law is "on a balance of probabilities" (51% certainty) and not, as under criminal law "beyond reasonable doubt" (99% certainty).

India

The Indian *Fertilizer Control Order*, the FCO, was promulgated four decades ago to ensure equitable distribution of fertilizers to all farmers (Tripathi, 1997).

About 20 grades of fertilizers are consumed in India. The most important are urea, DAP, SSP, MOP and various grades of complex fertilizers. Sporadic shortages and the value of the products, especially of P fertilizers, provide possibilities for adulteration, misbranding and black marketing. There is compulsory registration of fertilizer manufacturers, importers and dealers, and specifications of all fertilizers manufactured, imported and sold in the country must be given. The FCO also provides for the regulation of the manufacture of fertilizer mixtures, packing and labeling, appointment of enforcement agencies, setting up of quality control laboratories and prohibiting the manufacture, import and sale of non-standard or adulterated fertilizers. There is provision for the cancellation of registration certificates and for fines, and imprisonment from 3 months to 7 years. Being a subordinate legislation, it has flexibility and has been amended a number of times to bring it up-to-date. A revised FCO was promulgated in 1985.

Trade was initially regulated by Licensing Officers appointed by the State Governments for issuing licenses to dealers and registration certificates to manufacturers of mixtures. In 1969 the licensing system was replaced by registration, for dealers and manufacturers separately.

Over time there have been several changes in specifications and permitted grades and a number of micronutrient fertilizers were prescribed for the first time in October 1996. Tolerance limits are prescribed.

Inspectors have the power of search and seizure. In 1984 there were 52 fertilizers listed in Schedule 1, 43 laboratories in different states and one Central Fertilizer Control Laboratory.

Prior to 1973, the Government fixed prices in different states for different types of customers. In October 1973, the retention price scheme with

uniform prices for all states was introduced. Additional costs were permitted for small bags. In August 1992, all fertilizers except urea were decontrolled. After decontrol in August 1992 a provision was made for each importer to provide information about imports of DAP and MOP.

The FCO provisions can be grouped as follows:

- *Definition of terms.*
- *Price control.*
- *Regulation of manufacture and sale.*
- *Enforcement authorities.*
- *Specifications and tolerance limits.*
- *Sampling.*
- *Packing and marking on bags.*
- *Cancellation of dealers and manufacturers' certificates.*

By 1996/97 there were 61 laboratories with a capacity of more than 100 000 samples. During the past 10 years the number of non-standard samples has varied from 5.3% to 7.7%. However, 16% of NPK mixtures were non standard, varying from 5% to 73% according to the state.

The decontrolled fertilizers are exempted from price, movement control and supply plan, but the remaining provisions of the FCO still apply.

According to Tripathi, the main weaknesses at present are:

- *Inadequate laboratory capacity.*
- *Lack of full time inspectors.*
- *Multiplicity of grades - about 22 grades of NP/NPK fertilizers having the same nutrient ratio cause confusion.*
- *No private testing facilities for dealers and farmers.*
- *No classification of offenses into minor and major nature.*
- *Short weight is not an offense under FCO.*
- *Weak prosecution system - successful prosecutions are rare.*

Remedial measures, apart from increasing laboratory capacity and enforcement procedures include:

- *Restriction of granulated NP mixtures and their number of grades.*
- *Popularizing a quick testing kit for suspect stocks.*
- *Short weight to be declared an offense.*
- *Creating awareness amongst farmers of consumer courts.*

8.3 Regulation of particular fertilizers

Blends

In West Europe at present there is no distinction between blended and complex fertilizers in the European fertilizer directives. The EU Directive on Sampling and Analysis gives no special precautions for blends.

The US position is that the conformity of the sample with the nutrient content claimed by the seller is a sufficient indication of the quality of the blend. In the USA, the AOAC sampling methods are designed to collect a sample that represents the uniformity and nutrient content of a batch of fertilizer. A non-uniform batch of fertilizer, when sampled by AOAC methods, will yield a deficiency analysis, whether the product is a blend or a complex fertilizer.

Slow and controlled release fertilizers

In the United States, Europe, Israel and Japan a wide range of slow and controlled release fertilizers is produced and distributed. There are regulations on definitions and classification in the individual member states, but as yet there is no universally accepted consumer-protection for these products. Only Japan has introduced obligatory test methods.

In the USA, the AAOFCO has issued definitions for controlled-release fertilizers. They are working to prepare model legislation of so-called "Efficiency Design" (ED) products, meaning a product with characteristics that minimize the potential losses of nutrients to the environment. A task force, together with The Fertilizer Institute, TFI, has been established to define methods of analysis, labeling, enforcement etc.

In Western Europe, slow release fertilizers are not included in the list of EU fertilizers. A task force of the Centre Européen de Normalisation (CEN), which, among other activities, advises the European Commission, is preparing proposal on the classification of these fertilizers. There is consultation between the AAFPCO/TFI task force and the CEN task force.

Organic manures and fertilizers

Until the early 1980s there were few regulations concerning the disposal of organic manures but pollution of water, in particular from intensive livestock units, made regulation essential. Today most OECD countries have regulations concerning the storage and disposal of manures. The regulations deal particularly with emission into water courses, but in some cases the field application of organic materials is covered. In some countries there are limits to stocking intensity per ha. The use of sewage wastes is regulated in most countries, particularly on account of the risk of heavy metal content.

Organic and organo-mineral fertilizers are the subject of regulations in all member states of the EU but as yet there is no harmonization at the EU level. The definition and specification of these fertilizers pose difficult problems. Many materials are based on animal residues and sewage sludges, which adds to the difficulties. Organic fertilizers are offered on the market not only in developed countries but also in developing countries, especially in Asia, sometimes with extravagant claims. In these countries adequate standards and regulations are lacking.

8.4 Sanctions

Enforcement may be international, national or local, depending on the type of legislation. Sanctions may be under criminal or civil law depending on the offense. Sanctions include fines, in serious cases imprisonment or sometimes compensation to the consumer (purchaser). The national regulations also specify the ways in which the legislation is to be enforced, covering the qualifications and powers of the inspectors and the qualifications of the analysts.

Each type of legislation requires an appropriate group of enforcement officials, samplers and analysts as well as recognized official methods of sampling and testing. In addition, each production site should have a system of quality control and environment monitoring. The sampling and test procedures for the latter may not necessarily be the same as for enforcement but the results obtained should be equivalent.

The legislation may be enforced in a number of different ways through fiscal incentives, taxation, subsidies, environmental liability, civil law and market forces in general. In most developed countries, state and local advisory organizations are fully involved. Sanctions may include fines, in serious cases imprisonment, publication of offenders or in some cases compensation to the consumer (purchaser).

Consumer protection law is generally nationally (federally) enforced although the actual control may be devolved to local authorities. In the USA the federal government sets the guidelines but each state has its own legislation.

8.5 Labeling - an example, France

In France, fertilizer materials, the packing, labels and documents which accompany deliveries in bulk must include the legal designations defined in the texts, the French standard or the EU Directives. These designations are, for example, the type of fertilizer, the declared content of each nutrient therein, the form in which these elements are present and their solubility, fineness of grinding of the product etc. The designations are of two kinds: obligatory and optional. All are intended to inform, in a practical and transparent manner, the purchaser and user of mineral fertilizers. These designations are noted on the invoices so that the products may be marketed without ambiguity.

Designations

Straight nitrogen fertilizers

The content is expressed in nitrogen N as a % of the weight of the gross product.

Straight phosphate fertilizers

The content is expressed as P_2O_5 as a % of the weight of the gross product.

The different phosphatic fertilizers are characterized by their solubility in specific reactants; in addition, for certain phosphatic products, a fineness of grinding is specified.

Straight potash fertilizers

The content is expressed as potassium oxide (K_2O) as a % of the weight of the gross product.

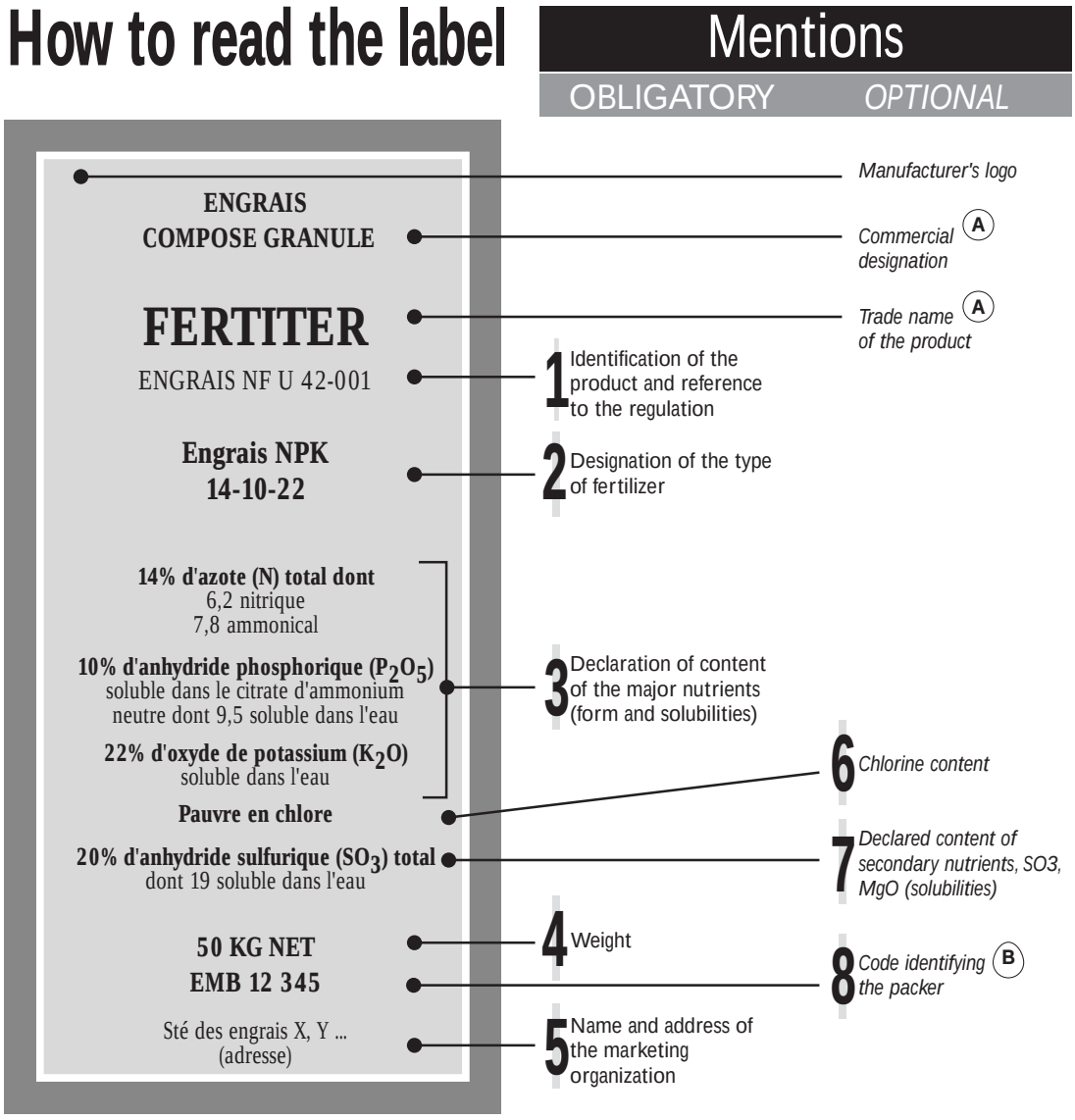
Compound fertilizers (NPK, NP, PK, NK)

The declaration of the fertilizer nutrients is made following the same principle as for each of the straight nitrogen, phosphate or potash fertilizers.

Particular methods of declaration are allowed for according to whether the compound fertilizer contains one or several phosphate constituents (see NF U 42-001 “complementary table concerning the phosphate component” and directive 76/116/EEC “compound fertilizers, indications for the identification of fertilizers”).

Organo-mineral compound fertilizers must contain at least 1% of organic nitrogen of animal or plant origin but not synthetic organic nitrogen. This latter form of nitrogen enters into the composition of a special category called “nitrogen fertilizers, compound fertilizer containing nitrogen and synthetic organics”. These fertilizers containing synthetic organic nitrogen are specified in annex 2 to NF U 42-001 Standard and in appendices I and II of EEC Directive 93/69.

An example - France



The numbers 1 to 8 correspond to the order of priority on which the indications must be indicated according to the standard serving as a reference.

(A) "Commercial designation", optional, must be clearly separated from the "designation of the type" which is obligatory.

(B) Mention is obligatory when the address of the bagging and weighing firm is not that of the firm marketing the product.

References and further reading

Beig M.F. *Fertilizer Import, Marketing & Distribution (in Pakistan): Issues and Policy Alternatives* Agriculture and Fertilizer Use by 2010, NFDC Conference, Pakistan, 5 pp., NFDC, Islamabad.

Brink M. (1996). *Regulatory Control of Fertilizers* (in Denmark), Fertilizer Society Proceedings No. 393, December 1996.

Byrd Jr. T. and Reddy S.K. (1982). *Minimizing Fertilizer Losses: Role of Contemporary Marketing Systems and In-Service Training*, FAO/FIAC meeting, Rome, March 1992.

Dante E. (1998). *Summary Results of the Survey on Fertilizer Marketing Costs and Margins in Asia and the Pacific, 1996/97*, FADINAP, Agro-chemicals News in Brief, July-September 1998, 11 pp., Bangkok.

EFMA (1996). *Guidance for the Compilation of Safety Data Sheets for Fertilizer Materials*, 124 pp., EFMA, Brussels

EFMA (1998). *Guidelines for Transporting Nitric Acid in Tanks*, 60 pp., EFMA, Brussels.

European Blenders' Association (1997). *Handbook of Solid Fertiliser Blending; Code of Good Practice for Quality*. Prepared by G.E.N. Lance. 32 pp. Le Pontoury, 50530 Montviron, France (for the French version; the English version is available from FMA, Thorpe road, Peterborough PE3 6GF, UK.)

FADINAP (1995). *Summary Results of the Survey on Fertilizer Marketing Costs and Margins in Asia and the Pacific, 1996/74*. Agro-chemicals News in Brief, July/September 1998. FADINAP, Bangkok.

FAO/FIAC (1990). *Fertilizer Retailing Guide*. 51 pp., FAO, Rome. (also available in French)

FAO/FIAC (1985). *Logistics of Fertilizer Marketing*. 11 pp. FAO, Rome.

FAO (1985). *Manual on Fertilizer Distribution*. FAO Fertilizer and Plant Nutrition Bulletin No. 8. 114 pp. FAO, Rome.

FAO (1994). Demand Forecasting for Fertilizer Marketing. 50 pp. FAO, Rome.

Fertiliser Manufacturers' Association *Guide to the Independent Evaluation of Solid Straight Nitrogen Fertiliser*. FMA, Peterborough, U.K.

Fertiliser Manufacturers' Association (1998). *Code of Practice for the Prevention of Water Pollution from the Storage and Handling of Fluid Fertilizers*, 25 pp., FMA, Peterborough, UK.

Fertiliser Manufacturers' Association (1998). *Code of Practice for the Prevention of Water Pollution from the Storage and Handling of Solid Fertilizers*, 32 pp., FMA, Peterborough, UK.

Heather D.J. and G.E.N. Lance (1994). *Legislation Affecting the Production, Distribution, Storage and Use of Fertilisers in the 1990s*, The Fertiliser Society Proceedings No. 352, U.K., 1994.

Hester L. (1996). *AAPFCO- Regulatory Update* Fertilizer Industry Round Table, Savannah, USA, October 1996.

IFA/UNEP (1998). *The Fertilizer Industry, the Environment and World Food Supplies*. 66 pp, IFA, Paris.

IFA/UNEP (1998). *Mineral Fertilizer Production and the Environment* (second edition), Parts 1 and 2, IFA Paris.

IFA/UNEP (1998) *Mineral Fertilizer Use and the Environment*, 51pp. IFA, Paris.

IFDC and UNIDO (1998). *Fertilizer Manual*, 615 pp. Kluwer Academic Publishers, Dordrecht, the Netherlands.

Isherwood K.F. (1996) *Fertiliser Supply from Factory to Farm: a Global Review*. The Fertiliser Society, Proceedings No. 386, 27 pp., York, UK.

Jarskog L. and Bowley K. (1996). *Improvements in Fertilizer Handling Technology and Equipment*. Agro-chemicals News in Brief, July/ September 1996. FADINAP, Bangkok.

Kenna M.R. (1998). *Environmental Compliance at the Retail Fertilizer Outlet.* The Fertilizer Industry Round Table Meeting, Annapolis, Maryland. 10 pp.

Lance G.E.N. (1996). *Theory of Fertiliser Blending*. Proc. Fert. Soc. No. 387, December 1996.

Martin D.M. and Carne R.S.N. (1997). *Product Stewardship*, The Fertiliser Society, Proceedings No. 406, 23 pp., York, UK.

O'Brien, R. (1998). *The Impact of Environmental Legislation on Fertilizer Use in the USA*, Fertilizer Demand Meeting, IFA Annual Conference, Toronto, May 1998. IFA, Paris.

Parthasarathi K. (1998). *Distribution. An Important Arm of Marketing Fertiliser Marketing News*, Fertiliser Association of India, New Delhi, 5 pp., December 1998.

Saiful Islam M. (1996). *Fertilizer Situation in Bangladesh.* Agro-chemicals News in Brief., September 1996, FADINAP, Bangkok.

Schultz J.J. and Clayton W.E. (1981). *Fertilizer Bagging and Blending. Some Experiences in Developing Countries*. ISMA Regional Conference, Brazil, October 1981. IFA, Paris.

The Fertilizer Institute, TFI (1996). *Bulk Blend Quality Control Manual*, Washington, Spring 1996.

The Fertiliser Society (1996). *Fertilisers from Factory to Farm*, Proceedings No. 394, 32 pp., York, UK.

Tripathi N. (1997). *Status of Fertiliser Quality Control in India*, Fertiliser Marketing News. May 1997.

UNIFA (1997). L*a Fertilisation*, 7th Edition. Chapitre XI, les Engrais. UNIFA, Paris, France.

A list of series booklets giving safety recommendations concerning the storage and handling of fertilizers and their intermediates issued by The European Fertilizer Manufacturers' Association (EFMA) and International Fertilizer Industry (IFA) is as follows:

- Safety Recommendations for the Large Scale Storage of Anhydrous Ammonia. 1985.
- Safety Recommendations for the Storage of Hot Concentrated Ammonia Nitrate Solutions. 1985.
- Safety Recommendations for the Use of Anhydrous Ammonia in Agriculture. 1985.
- Summary of Recommendations for the Safe Handling of Fertilizers containing Nitrogen. 1985.
- Recommendations Concerning Rubber Hose for Use with Ammonia. 1987.
- Recommendations for Safe Storage and Handling of Wet Process Phosphoric Acid. 1990.
- Hazardous Properties of Ammonia. 1990
- Selected Tests Concerning the Safety Aspects of Fertilizers. 1992.
- Handbook for the Safe Storage of Ammonium Nitrate Based Fertilizers. 1992.

PART 2. CASE STUDIES

Introduction

As mentioned in Part 1 of this publication, the distribution sector not only accounts for a substantial proportion of the delivered cost of fertilizers, but also it is often the only part of the plant to farm system whose costs can be influenced significantly. Yet it is a sector which receives inadequate attention. In addition, it is the retailer who is in direct contact with the farmer and who is therefore well placed to give advice on the use of the product he sells. Also it is in the distribution sector that value can be added to fertilizers by providing remunerated services to the farmers. The increasing environmental awareness, with productive agriculture one of the main targets for criticism, together with the possibilities offered by information technology, are resulting in an increasing sophistication in agricultural techniques, a sophistication which can be serviced by the distributor who is in direct contact with his farmer-customers. The information given in this publication demonstrates the growing importance of the farmer services provided by the retailer in certain countries, particularly North America, and their almost total absence in most other regions.

In this part, information is assembled on the fertilizer distribution systems in different countries and regions of the world. The country information demonstrates the very wide range of systems established for the distribution of fertilizers, especially in countries where their use has been established for well over a century.

Unfortunately, even in many developed markets, the profit margins available on mineral fertilizers permit only minimal service. In West Europe, for example, until the mid-1970s the fertilizer industry could fairly be called "knowledge-based". Subsequently, it has tended to become a commodity-based industry, increasingly taking low-cost basic fertilizers from regions with natural resource advantages. In the USA, it is largely the distribution sector, especially the co-operatives, which are taking the lead, although there are exceptions.

Hence, while the need to improve the efficiency of fertilizer use becomes increasingly urgent, the means of achieving improvements are grossly inadequate. Fertilizer manufacturers no longer have the financial means to provide substantial services while governmental advisory and research services have been run down in many countries. In many cases, the retailer not only has inadequate margins to finance services but also requires to be trained.

There is no evident solution to this dilemma, but if some remedial action is not taken the praiseworthy aim of "sustainable agriculture" will not be achieved.

1. Regional overviews

The regions described in this overview are as follows:

1. West Europe
2. Central and East Europe
3. North America
4. Latin America
5. Sub-Saharan Africa
6. Asia

1.1 West Europe

In the 1920's and 1930's fertilizers in West Europe were handled in large jute bags (about 100 kg). These were popular with farmers since they could subsequently be used for other purposes. From the late 1940's these were replaced by 50 kg paper bags which, in turn, were replaced by plastic bags in 1960's. It was from the late 1960's that the large-scale development of mechanized systems of handling fertilizers developed in countries where the agricultural structure provided a strong demand for such systems.

The general use of welded plastic sacks has led to a simplification of storage conditions. Although it is may be possible to store these bags in the open air for a few weeks, covered with a plastic cover to protect them from rain and the sun, it is preferable to shelter them in a clean store, isolating them from the ground end the walls, to avoid substantial humidity differences and rodent attacks.

One feature of the fertilizer industry of West Europe is the importance of complex fertilizers. In the case of nitrogen, a substantial proportion, about 74 %, must be applied in straight form for agronomic reasons, for example on grass or as a top-dressing. In the case of phosphate, 84% is applied as granulated NPK/PK/NP complex fertilizer. The complex fertilizers are produced by both the phosphoric acid and nitrophosphate routes. However, many phosphoric acid plants have closed in recent years due partly to economics and partly to the problems of disposal of phosphogypsum. Many complex fertilizer plants have closed and others use bought-in phosphoric acid.

The use of bulk blends has developed in recent years, favoured by mergers and acquisitions, the wider-availability of improved intermediates, particularly as regards the granule size, uniformity and stability, and the availability of "Intermediate Bulk Containers", IBCs.

Table 1. Estimates of bulk blends as a % of total fertilizer deliveries

Denmark	9%
France	8%
Germany	4%
Netherlands	7%
Norway	0
Spain	8%
UK	10%

Source: IFA

To these must be added the blended fertilizers produced by several large fertilizer manufacturers in West Europe in fully automated, large-capacity plants, producing an excellent product, often bagged and sold through the established marketing networks. In Ireland, for example, all the NPK compounds are produced in this way.

The present position and trends in some West European countries are shown in table 2.

Table 2. Proportions of different systems

	Denmark	Germany	Nether-lands	Norway	Spain	France	UK	Ireland
To the farm								
Bulk	83	80	83	1	20	34		8
Bulk blends	9	4	7	0	8	9	10	
Loose bags	0	0	0	0	58	2	0	
Palleted bags	7	3	10	51	10	21	16	71
IBCs	0	0	0	48	0	18	65	21
Fluids	1	13	1	0	3	16	9	
To the distributor								
Bulk solid	91	84	100	55	82	69	10*	

(Totals may not add exactly to 100 due to rounding)
**blends*
Source: IFA

In certain countries, Denmark, Germany and the Netherlands, solid bulk fertilizers now account for over 80% of the total market. Autumn applied PK compounds are often delivered in bulk. The use of IBCs, which are intermediate between bulk and the 50 kg bag, has become significant. In Norway almost half and in the UK more than half of fertilizers are now delivered to the farm in IBCs . In the more southerly countries, 50 kg bags still predominate.

In West Europe liquid fertilizers have achieved real importance only in France. The consumption of fluid, suspension fertilizers is very small.

In West European countries, the proportion of fertilizers sold directly by the producer to the farmer is small. More fertilizers physically go directly from the producer to the farmer than are indicated by the figures, but they are invoiced by the distributor (see table 3).

Table 3. (in pourcentage %)

	Direct by producer	Wholesaler /retailer	Cooperatives
Belgium	5	87	8
Denmark	0	36	64
Finland	0	40	60
France	0	45	55
Germany	0	41	59
Ireland	0	48	52
Italy	4	46	50
Norway	0	30	70
Netherlands	0	55	44
Spain	5	80	15
Sweden	0	20	80
UK	18	62	20

The following information on individual countries illustrates the diversity of fertilizer distribution systems in West Europe:

Denmark

94% of fertilizer is supplied form the producer in bulk and 6% in bags, mainly for horticulture. 88% goes direct to the farm, 5% to dealers warehouses. 40% is delivered by truck, 50% collected directly by spreader, either hired from the wholesaler or farm-owned.

France

Nitrogen is sold 54% as solid straight fertilizer, 28% as liquid and 18% as compounds. Urea ammonium nitrate solutions, UAN, account for 17% of the total fertilizer market. P and K are 70% in compound form. Bulk accounts for 43% of total fertilizer, of which 8% to 10% is blends. The shares of Intermediate Bulk Containers (18%) and bulk (43%) are increasing, whereas those of palleted bags (21%) and loose bags (2%) are falling. Liquids at 16% are stable. 65% of the product leaves the factory in bulk, some of this being bagged before distribution to the farm.

Germany

80% of fertilizers are delivered to the farm in bulk, plus 4% of blends. Fluid fertilizers account for 13%, palleted bags for 3%. 94% of the domestically produced bulk fertilizer leaves the plant by rail (although much of the imported fertilizer is transported by road or water).

Ireland

The majority of sites, whether manufacturing or blending are situated around the coast or a few miles inland. About 60% of Irish fertilizer is imported in one form or another. 71% of the market is supplied in 50 kg bags, 21% in 500 kg IBCs and 8% in bulk. The 50 kg bags are generally shrink wrapped on 2-tonne pallets. In view of the lack of grain production there is a lack of storage facilities and it is an advantage that the fertilizer can be received in packages. The choice for the blender or manufacturer was between building large and costly storage facilities or using plastic packages.

Netherlands

For grassland, most product is delivered in bulk to silos on the farm. These silos are partly used for cattle feed during the winter months. 80% to 85% of fertilizers are in bulk, with smaller deliveries late in the season in 50 kg bags. IBCs are little used. Palleted bags account for 10%, a proportion that is tending to decline. 90% of the bulk goes to the first destination by barge. For arable farms, 60 to 70% of deliveries are in bulk, less than 5% is in IBCs, the remainder in 50 kg bags.

Norway

Norway is exceptional in that 51% of fertilizers are delivered to the farm in palleted bags, the remainder in 600 kg IBCs . Much of the fertilizer is transported to the first destination by coastal shipping.

Spain

Three quarters of the fertilizer leaves the plant in bulk but most of this is bagged and only 20% is delivered to the farm in bulk, plus 8% in blends. 58% of the fertilizer is delivered in loose bags, a proportion which is tending to fall to the benefit of the other systems. 10% is delivered to the farm in palleted bags.

UK

The United Kingdom is exceptional in that 80% of the fertilizer is delivered to the farm in IBCs , normally of 500 kg. 20% is delivered on palleted bags. The proportion of IBCs is tending to increase at the expense of palleted bags. All transport is by road.

Customer services

From its inception in the middle of the nineteenth century until the mid-1970s, the West European fertilizer industry was, at least in large part, a knowledge-based industry. Since then it has tended to become increasingly a commodity industry. The result has been considerable restructuring of the fertilizer industry in West Europe and a very large reduction in the industry's agricultural research and extension activities. In the process, many intellectual resources have been lost. However, there are exceptions (see the study on Spain).

1.2 Central and East Europe

Under the centrally planned system which prevailed until 1989, fertilizers were allocated rather than sold. Today farmers have to pay for the fertilizers, and the distributor has to pay the supplier. Previously, the fertilizers were distributed by state-owned organizations. In theory, fertilizers were made available to the large state and co-operative farms based on agronomic recommendations derived from soil tests etc. In practice, without economic discipline, the recommendations were often not put into practice, for various reasons.

With the transition to market economies, the state distribution organizations have been largely privatized but an efficient distribution sector has still to emerge.

The structure of agriculture varies greatly, with large farms remaining predominant in the Czech and Slovak Republics, Hungary and the west and north of Poland, small farms in the east of Poland and Romania and a confused situation in Bulgaria. There are still problems of land ownership and title to land in some of the countries.

Under the centrally planned system, fertilizers were delivered largely in bulk or as liquids to distribution centres, or often directly to the large state and cooperative farms. However, in view of the drastic fall in fertilizer consumption and the changes in the distribution systems and in the agricultural structures, new patterns are emerging.

The situation in the agricultural marketing sector is unsatisfactory. If the farmer cannot sell his produce at a satisfactory price he is unlikely to buy inputs. Under the centrally planned system, a single state-owned firm in each country had a complete monopoly over the purchasing, processing and distribution of the main agricultural commodities. Today, in all the countries of the region, there has been privatization of the distribution sector but, in many cases, the state organizations have been replaced by oligopolistic or monopolistic private firms. Farmers' incomes continue to be reduced unnecessarily by inefficiencies in the downstream sector. The entry of private firms to compete with the regional monopolies has been hindered by lack of capital and management skills.

Bulgaria

Nitrogenous fertilizers are supplied to the domestic market essentially in bags, although some (stabilized) ammonium nitrate and TSP are supplied in bulk.

Czech Republic

Large farms receive fertilizers in bulk, smaller farms in hill areas in loose bags. Some 70% of fertilizers leaves the plant in bulk, some of which is subsequently bagged. Some 60% of fertilizers are delivered to the farm in bulk. In the 1980s 70% was in liquid form, today the proportion is 30%. Today the share of liquids is again tending to increase, as is that of bulk, at the expense of loose bags.

Hungary

In recent years there has been an increase in bulk. Liquids are not increasing - there is a lack of farm storage and not enough machinery suitable for application on the large farms. The average farm size is 300 ha.

Poland

Today about 6% of fertilizer is in liquid form using plant protection sprayers for application on small farms - while not ideal the liquids applied in this way are at least applied more efficiently than solids usually are. 80% of fertilizers are in 50 kg bags. Bulk blends in 1997 amounted to 200 Kt product, 8% to 10% of total consumption. 6% is in IBCs , whose use is increasing.

Romania

Fertilizers are supplied to the domestic market essentially in bags. Some quantities are taken in bulk by farms located close to the plants.

The Russian Federation

(Extracted from an FAO Special Report, 9 November 1998)

Cereal yields have demonstrated a weak downward trend in the past 8 years, with the strongest downward trends in wheat and barley. These trends reflect the historic concentration of cereal production in the large-scale enterprises. Even before the 1998 financial crisis, most large-scale enterprises were operating at loss-making or break-even levels, kept afloat only by soft loan terms and ineffective debt recovery. Low efficiency can be attributed to many factors, including weak development and penetration of upstream and downstream market structures, unfavourable local land and price policies and poor farm management.

The upstream services are erratic and constrained by poor management and high risks (of non-payment) associated with the provision of inputs. A variety of trading organizations has emerged on the domestic market, including large-scale private grain traders and smaller local operations, partly supplanting the parastatal procurement agencies. However, the benefits of a more competitive wholesale trade have yet to be realized in terms of transparent market signals at the farm-gate.. The reasons for continued weaknesses in the downstream sector are complex and vary from oblast to oblast. The most frequent constraints are as follows:

- Farm enterprises are not free to choose the destination cereal elevator. Regional authorities often allow deliveries only to specific elevators, where they can control both volumes and delivery prices, usually to the disadvantage of producers;
- Erratic market intervention in all parts of the marketing chain, including state procurement, internal tariff and non-tariff trade barriers and price regulation increase risks and transactions costs for traders, reflected in relatively high marketing margins;
- Legal structures for recording and enforcing forward contracts are under-developed, so default risk for linked credit (or in-kind inputs) for sales deals is high.

The lack of comprehensive price information, and non-existent futures market may also lead to under-bidding. Farm enterprises are often ill-informed of the prevailing farm-gate and elevator delivery prices. Although the Ministry of Agriculture and Food has a price information pilot project, the data (from around 30 oblasts) are not widely distributed.

It is unrealistic to expect efficient farm management under these circumstances, in spite of soft but essentially rationed farm credit. Furthermore, the rapid transfer of farm ownership into joint stock companies was not accompanied by effective management shakeouts. With unclear ownership, incentives for efficient management are often lacking. Another frequently cited reason for the inefficiency is that managers are unfamiliar with the “laws of the market economy”, particularly complex for grain producers.

Since there are significant economies of scale, the large-scale enterprise sector dominates cereal production, as well as sugar beet and oilseeds. Official estimates suggest that only 7 percent of 1997 cereal output came from private farms or household plots, the lowest proportion in all the CIS countries, although the share has increased considerable since 1991. In contrast, potato and vegetable crops are mainly cultivated on household plots and private farms. Production on such plots has been increasing in both relative and absolute terms in recent years.

Customer services

In general, services provided by the distribution sector to the farmer are very poorly developed in this region. This presents a challenge and an opportunity.

1.3 North America

Dry fertilizers accounted for nearly 90% of all distribution in the USA in 1960, and nearly 77% of all dry fertilizer was handled in bags. By 1983, the ratio had shifted to 51% of fertilizer distribution being handled in dry form, with less than 14% of that total distributed in bags. Distribution of fluid fertilizers comprised 7% of total fertilizer in 1960. Today, fluid fertilizers, including anhydrous ammonia, accounted for about 40% of the total.

At the beginning of the 1960's, complexes were the predominant form of compound fertilizers also in the USA, although they tended to be produced in relatively small plants. In the mid-1960s there were approximately 200 NPK complex fertilizer i.e. ammoniation/granulation plants, in operation in the United States. According to the 1994 IFDC survey, there are now 25 plants in operation. In 1994 they produced some 1.6 million tons product, which is well below their design capacity of 3.7 million tons.

The development of blends in the USA is due partly to the location of fertilizer production and consumption, which favours handling in bulk - liquid and solid - and it favours blends. The production points of the primary materials are located far from each other, phosphates in Florida and the South East, potash in Canada or New Mexico, nitrogen on the Gulf Coast. These materials need to be brought together in yet another location, the major consuming area of the Corn Belt. The fertilizer ingredients, produced in large, cost-effective plants, are transported to the area of consumption and mixed there. The river transport facilities to the Corn Belt and, in the case of fluid fertilizers, a well-developed pipeline system, have facilitated these developments.

A comparison between the USA and West Europe is given in the following table.

Table 4. Proportions of fertilizer applied

	USA	West Europe
Anhydrous ammonia (% of N)	32 %	neg.
N solutions (% of N)	23 %	9 %
Fluid compounds (% of compounds)	21 %	neg.
Bulk blends (% of solid compounds)	80 %	25 %

Source: TFI and IFA

The following text is extracted from an IFDC report (1997).

The consolidation of the fertilizer production system in the United States into fewer and larger plants has been matched to some degree by consolidation in the distribution, wholesale, and retail system and also in the number of farms. At just under 2.1 million in June 1996 there were 14% fewer farms than in 1981. Average farm size had risen to about 200 ha (470 acres). The number of customers served is shrinking at the wholesale, retail, and farm levels.

In the USA, retail operations are in some cases operated by basic producers or are local cooperatives which are members of regional cooperatives. Two regional cooperatives are basic fertilizer producers. In addition, private independent retail operations are increasingly being consolidated into larger chains of retail outlets, and in the past few years many of these retail chain operations have been bought by basic producers. There are still many independent retail chains and single small businesses.

1.4 Latin America

In Mexico the government subsidized fertilizers heavily during the 1970s and 1980s. In the 1980's, Fertimex was the only Mexican (state-owned and managed) fertilizer producer and importer. Some 150 different distributors serviced the needs of the market; all of them had specific territories and a relatively simple function, namely the provision of sufficient warehousing and transport facilities to meet the requirements of Fertimex production units. The distributor received a pre-arranged commission for every bag sold to the farmers. Competition was not an issue. Prices were fixed by the government.

In 1989, following the guidelines of the National Development Plan, the marketing system was reorganized and Fertimex withdrew from the secondary and tertiary distribution systems. Subsidies were gradually withdrawn. Probably 30% to 40% of the former Fertimex dealers remain operational today. (Distributing Fertilizers in Mexico, by L.M. Romero Gonzalez, Fertilizer Focus, FMB, May 1997).

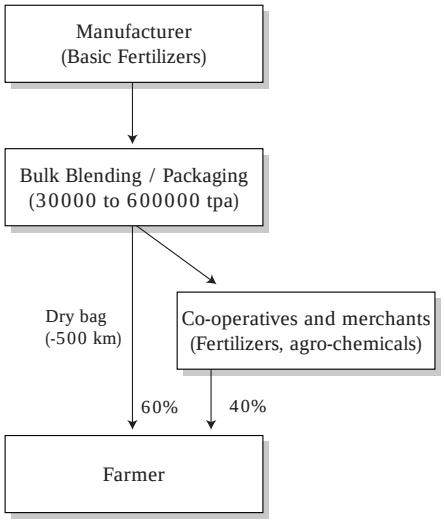
Similarly, the fertilizer distribution sector has been privatized in Venezuela, with the development of an extensive bulk blending programme.

Customer services

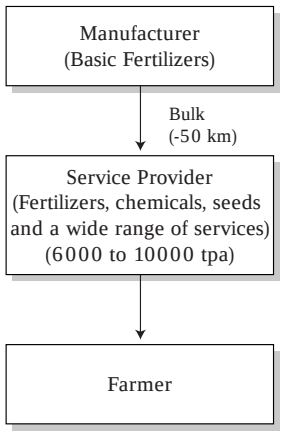
In a paper presented at The Fertilizer Institute's Conference held in New York in September 1999, Dr. R.J. Rennie of Agrium Inc. described his company's activities in developing a fertilizer distribution system in Argentina. AgroServicios Pampeanos S.A. (ASP) is a newly formed agricultural retailer based largely on Agrium US's Crop Production Services model. Its 18 Farm Centres, spread throughout Argentina, are developing the bulk and blended granular fertilizer market. ASP is introducing soil testing and fertilizer recommendations, bulk fertilizer blending and prescription application of agricultural chemicals. In addition, ASP has a strong storage and distribution infrastructure. Each of the 18 farm centres has a blender and 7 bins with 300 t of storage capacity. 16 of the 18 farm centres are on rail. The rolling stock, imported from the USA, includes AgChem's Terra Gators, Rogators and various tenders. ASP was also the first agricultural retailer to receive a bulk chemical blending license. ASP also undertakes extensive research plots to demonstrate the benefits of their products.

At an IFA conference held in Buenos Aries in October 1999, Brazil, Mr. M. Barbosa Neto of Fertilizantes Serrana SA, Brazil, compared the established model of fertilizer retailing in Brazil with a typical system in the United States, illustrated by the two following diagrams:

1. Producer/Distributor (e.g. Brazil)



2. Service Provider (e.g. USA)



1.5 Sub-Saharan Africa, SSA

Until 1990, the governments of almost all the developing countries of Africa were heavily involved in the fertilizer sector. This meant a high level of regulation, licensing, price control and import monopolies. Special public sector structures, mostly aid-financed, were established in the 1970s and 1980s for the distribution of fertilizers. These structures were generally inefficient. Fertilizer subsidies were widespread in sub-Saharan Africa, both implicit, due to overvalued exchange rates which made imports cheaper, and explicit through direct payments.

However, the subsidies were a heavy burden on the limited financial resources of these countries and during the 1980s the World Bank imposed financial structural adjustment programmes (SAPs) in 24 countries in Africa, and another 9 countries were affected by similar operations. Almost all these operations included conditions relating to agricultural subsidies. Their removal was justified on the grounds that they distorted the allocation of resources, precluded privatization of the distribution sector and that the burden on the national budget was too great.

There were then moves to privatize and deregulate the distribution systems, but the privatization of fertilizer distribution in African countries with a relatively low level of fertilizer consumption on food crops has not proved successful. (The large estates and the export crop sectors in Africa often have their own arrangements for obtaining their fertilizer supplies). In the case of the food crop producer, the would-be private dealer is working in an unfavourable economic environment. Demand is low, irregular and dispersed, there is considerable financial and credit risk, stock turnover is relatively slow, there are high financing charges, the demand is seasonal and the product is cheap but bulky. Dealers in a privatized fertilizer marketing system evidently want to concentrate on business in high consumption, easy-access areas. Small farmers practicing agriculture close to subsistence level may be left without access to farm inputs.

Fertilizer prices for the African farmer are often high and food crop prices low. The quantity of grain required to purchase one kg of nitrogen varies from 6 to 11 kg, compared to about 2 or 3 in Asia. The cost of imported fertilizer is high because of the small volumes and the cost of distribution is substantial, due to high transportation costs, lack of storage facilities and inefficiency. The cost is particularly high in land-locked countries. However, the results of FAO's Fertilizer programme in the 1970s and 1980s demonstrated that the response to fertilizers at the low levels of application normally practiced is substantial and the fertilizers, if well used, may be economic in spite of the high price. This was certainly the case in high rainfall areas.

Customer services

Few services are provided to farmers by the retail sector in this region. Even in the highly-developed fertilizer market in the Republic of South Africa, the services are deteriorating despite a need for the opposite.

1.6 Asia

In India 66% of fertilizers are distributed by private retailers and 34% by government outlets and co-operatives. There is a total of 261 000 retail fertilizer outlets, of which 71 000 are private and institutional and 191 000 private, serving more than 627 000 villages. The policy of the Government of India is to encourage private retail outlets for fertilizer distribution.

In Pakistan there are some 9000 private dealers and public sector provincial market agencies with 463 sales points. In 1998 69% of fertilizers were distributed through private wholesalers and retailers, the remainder by co-operatives and government outlets. The objectives are decontrolled prices, deregulated markets, reasonable rail tariffs and rail movement priority and an improved road network.

In Bangladesh, fertilizer distribution has been progressively privatized over a period of years, with the assistance of USAID and other donor agencies (Saiful Islam, 1996). There are some 112 000 retailers active in the fertilizer trade, 1300 wholesalers and 40 importers/distributors. The sector employs some 170 000 people. However, the transition has not been without its problems.

In China, the distribution of fertilizers is essentially government-controlled. The China National Agricultural Means of Production and the All-China Federation of Supply and Marketing Cooperatives manage the distribution of agricultural inputs. Until recently fertilizers were sold only through authorized local agricultural material supply companies, at fixed prices to farmers.

In mid-November 1998, the State Council of China issued a circular calling on implementation of a new fertilizer distribution system to increase profitability for fertilizer producers and guarantee fertilizer supplies for farmers. The reform has given fertilizer producers the freedom to set prices in line with market fluctuations and to sell products directly to farmers.

Customer services

A feature of the Indian fertilizer industry is the extent of farmer-support given by the larger producers. A number of fertilizer manufacturers run Farmers Service Centres (over 600 in all). The different agricultural inputs are all available under one roof. Among the services offered are advisory services, soil testing facilities and hire services for heavy machines. companies.

2. Country overviews

Africa - Sub-Saharan

The following are the recommendations concerning fertilizer distribution in Sub-Saharan Africa of (1) Sasakawa Global and (2) IFDC:

1. Sasakawa Global. Source: "The Sasasakawa Global 2000 Experience with Small-Scale Farmers in Sub-Saharan Africa" by Wayne L. Haag, Journal of the Fertilizer Society of South Africa, FSSA, 1999.

The agricultural input supply systems

Inputs must be available and affordable to small scale farmers. This is usually not the case in most of the countries Sasakawa is active.

Most of the SG2000 policy related efforts involving national political leadership and donor organizations relate to this issue. There is progress, but only very limited and far to slow.

While the policy issues are being worked on continuously, SG2000 also works with the private sector to encourage the development of input delivery systems. The Demo(nstration) Programme itself stimulates a demand for the use of inputs. In this process, working relationships are established with input wholesalers and retailers. The following are some ways in which we have attempted to stimulate the input delivery system:

1. Purchase of inputs for the demonstrations from the private sector rather than from government or other sources.
2. Encourage the wholesalers to furnish products on credit to retailers. In some cases we have provided modest loan guarantees.
3. Providing resources to improve a retail outlet. Investment in remodelling the sales site, making sign boards for advertising, etc.
4. Involve the private sector in planning the demo programme, field days, etc.
5. Meet certain travel expenses of private sector personnel when they are involved in joint activities with the extension service.
6. Work with IFDC and IFA in understanding better the fertilizer supply situation and with NGOs in training retailers.
7. Develop a formal collaborative programme with Monsanto for promoting no-till technology among small scale farmers.
8. Generally promote a spirit of collaboration aimed at promoting public/private collaboration.

He recommends that *retailers should handle a series of products, seeds, fertilizers, agro-chemicals, as well as other agricultural supplies, rather than concentrate on a single input.*

2. IFDC. Source: "A Strategic Framework for African Agricultural Input Supply System Development", IFDC, Muscle Shoals, Alabama, USA, 1999.

Some "constraints to sustainable input supply systems in Sub-Saharan Africa" were identified. The constraints were broadly categorized as:

- Policies and regulations which often discriminate against the private sector and discourage competition-,
- Unsound government investments, often with donor acquiescence, in new projects while neglecting maintenance and rehabilitation of existing infrastructure and supporting services;

- Insufficient knowledge and skills in both the public and private sectors.

In addition, more specific constraints reported in the literature, country studies and surveys include:

- Inadequate, ineffective, and inefficient financial and other facilitating services;
- Inadequate incentives for inputs marketing, farm production, and output marketing;
- Unfair competition practices such as the use of subsidized distribution by public sector and some NGOs;
- Distrust of private sector traders and middlemen;
- Resistance to change by privileged individuals (the rent seeking coalition benefitting from the status quo;
- Lack of market information and communications;
- Low and variable commercial demand;
- Abrupt subsidy removal and other policy discontinuities undermining private sector confidence;
- Frequency of pan-territorial pricing which removes incentives for private sector response to remote area demands;
- Inconsistent and poorly enforced regulations combined with active corruption and patronage;
- Poor contract enforcement;
- Inadequate physical infrastructure and communications capacity;
- High costs of input delivery and product marketing due to the distances involved and inadequate transport infrastructure;
- Lack of technical knowledge and business skills in all agribusiness sub-components;
- Limited coordination of donor activities.

Argentina

by Ricardo Melgar, Fertilizar April 1999

Most fertilizers currently consumed in Argentina are imported (90%). Wholesale importers, about 6 firms, and the urea producer, Profertil, sell directly to the large farmers in bulk or in bags. This accounts for about 50% of the total. The another half is sold to retailers, who supply farmers. Cooperatives account for only about 10% of the total consumption. A small portion (less than 5%) is imported directly by users from neighbouring countries.

In 1998, about 30 to 35% of the consumption was in bulk, with a growing trend. This season it is expected to increase to 40%. Fluid fertilizers, N solutions and anhydrous ammonia, amount to about 40 000 tonnes or less than 3% of consumption, but fluids also have a growing trend.

The importers take cargoes at the ports near the consumer areas and the internal movement is by truck. A small proportion (less than I0%) is moved by rail There is no barge transport.

There is only one producer of urea, PASA S.A. which in turn is also a big importer, having a market share of 25%. In year 2000 Profertil's large new plant will come on stream but the distribution system should not change much. The owners of the big company Profertil are YPF and Agrium, each of which has its own retail system.

Both PASA and Profertil comply with the ISO quality (ISO 9000) and environmental (ISO14000) norms. Distributors (Wholesale or retailers) are required to meet environmental safety rules in most cases only for new installations.

Australia

by B.G. Hunt, formerly of the Fertilizer Industry Federation of Australia, FIFA July 1995

1. Distribution network

Product is either collected (mainly by road) from producers' storage / dispatch facilities or from producers' or distributors' regional storage and distribution centers.

2. Sales to the farmers

	% of total retail sales
Direct by the producer	68
Private wholesalers/retailers	64
Co-operatives	6

3. Forms of deliveries

	From the plant	Trend*
Bulk (solid)	61 %	
Bulk blends	18 %	
Palleted bags	11 %	
Big bags	10 %	

* Increase Decrease

Estimates of **physical losses** of sold fertilizers between the factory or port gate and the farm: Average 0.5 %.

4. Transport

Transport to the first destination:

	Rail	Road	Water
Bags	1 %	21 %	-
Bulk	6 %	71 %	1 %
Weighted average distance to first destination:	275 km	170 km	300 km

Peak distribution months:
In temperate zones: March to June.
Tropical zones: Overall pattern is fairly even with various crops balancing out.

Austria

by Eichinger Horst, Agrolinz Melamin GmbH April 1999

1. Distribution network

Agrolinz's sales in Austria are to private wholesalers and co-operatives using Agrolinz sales people.

2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	67
Co-operatives	33
Total	**100**

Summary	**%**
Public sector	-
Private sector	67
Co-operatives	33
Total	**100**

3. Forms of deliveries to the first destination

	From the plant	Trend*
Bulk (solid)	77 %	
Palleted bags	23 %	
Big bags**	neg.	
Fluids	neg.	

* Increase Decrease

4. Transport to the first destination

Transport to the first destination:

	Rail	Road	Water
Bags	5 %	18 %	-
Bulk	25 %	40 %	12 %

Weighted average distance to first destination:

200 km	170 km	220 km

5. Fertilizer distribution and the environment

The department for Quality, Environment, Security and Health (QESH) of Agrolinz has written an “Integrated Management Handbook for Quality and Environment”.

Bangladesh

Extracted from "Fertilizer Production and Use in Bangladesh", by Dr. Md. Shariful Huq, Karnaphuli Fertilizer Co. Ltd. (KAFCO), published in Fertilizer Focus, May 1999.

Fertilizer distribution

With the objective of increasing fertilizer application, balancing the nutrient ratio and ensuring timely availability, the Government has implemented a number of major policy reforms in the fertilizer distribution system. Marketing and distribution, including importation responsibilities, have now been totally vested in the private sector.

However, the importation of urea, which started in 1996-97, is being made through BCIC on behalf of the Government of Bangladesh, due to its importance stemming from its extensive use and the regulation of domestic market prices.

The private sector has been entrusted with various responsibilities such as educating farmers on soil fertilization using chemical fertilizers, market research and quick dissemination of information, with the Government supporting the implement of programs and providing the policy frameworks. It is expected that continuing efforts by the private sector, adoption of free market policies, unrestricted imports and a demand-supply based pricing policy will help to maintain a sustained growth rate in the use of fertilizers and result in increased awareness of the importance of balanced fertilization, improving the N:P:K use ratio.

The following text is extracted from "IFDC's Experience in Development Programmes in Developing Economies with Special Reference to Africa" by Amit H. Roy and John H. Allgood, IFDC, published in the Journal of the Fertilizer Society of South Africa, FSSA, 1999.

"IFDC began its work in Bangladesh in 1978. At that time, most analysts considered there was little hope of Bangladesh ever growing enough basic food to feed its people. The food supply was dependent upon donor aid, but malnutrition was still severe. The overall goal of our work was to increase food production through increased fertilizer use on an equitable basis. At the time the project began, the Bangladesh Agricultural Development Corporation (BADC) was distributing about 730 000 tonnes per year of fertilizers to Bangladeshi farmers. Among other inefficiencies, late arrival of imports was common, advisory services for farmers were non-existent, physical losses of fertilizers were high, and farmer access to fertilizers required traveling long distances to reach supply points. With three long-term expatriate staff and significant staff of Bangladeshis (about 200 at one point), IFDC initially sought to improve the efficiency of BADC. Simultaneously, IFDC began work to stimulate private sector participation in fertilizer retailing. Subsequently, based upon the private sector's performance and expected further benefits that would accrue to increased private sector involvement in the wholesale and distributor level, the government in a phased manner relaxed essentially all policies that impeded private sector investment and participation in fertilizer importation and marketing. IFDC provided technical guidance to the government on policy issues, and worked with the commercial banks to assist private sector entrepreneurs in better understanding the nature

of the fertilizer business and encouraged the banks to expand their lending practices to include this emerging business sector. Assistance was also provided to private enterprises to develop their fertilizer knowledge and business acumen and to intensively promote improved fertilizer use management through training, farm-level demonstrations, and point-of-purchase advertising. During the life of the Fertilizer Distribution Improvement Project in Bangladesh, the following significant achievements were realized:

1. Fertilizer use increased by an average of 8% per year reaching 2,3 million tonnes of product by 1994.
2. By 1994, all fertilizer marketing in Bangladesh was in the hands of the private sector, with active participation of an estimated 108,000 fertilizer retailers/ stockists, 13 000 wholesalers, and 1 400 distributors.
3. Between 1988 and 1994 the government of Bangladesh saved an estimated US $119 million due to subsidy removal.
4. The commercial banks added this sector to their loan port-folio and during the life of the project loaned US $389 million toward working capital to fertilizer enterprises, with a 99% recovery rate.
5. Improved efficiency and increased farmer profits by about 35%.

Most importantly, the improved use of fertilizers was one of the keys (along with expansion of irrigation and use of high-yielding variety seeds) to Bangladesh achieving self-sufficiency in rice production in the early 1990s.

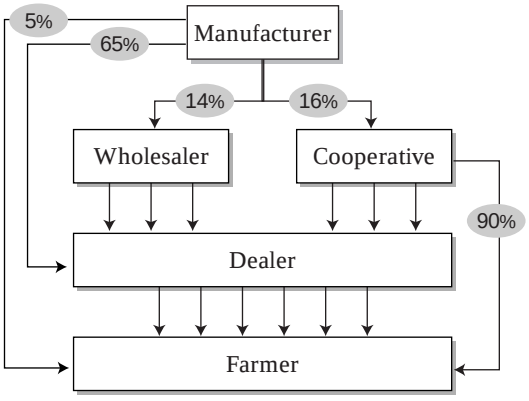
The Fertilizer Distribution Improvement project was key to improving food security and promoting economic development in Bangladesh. The project was also instrumental in influencing the development assistance efforts of the donor community. The project is recognized as a model of the transition from a government controlled and operated fertilizer marketing system to a market-oriented system with involvement of the private sector. Some of the key lessons learned from the project are:

1. Policy changes can change the economic efficiency of the agriculture sector.
2. Competitive market forces play a major role in stimulating agriculture sector efficiencies.
3. Donors and project implementation staff working in concert with the government is essential for project success.
4. Technical assistance, training, and access to credit are essential to entrepreneurial development.
5. The benefits of policy reforms must be explained continuously to the public and private sectors.
6. Consideration must be given to government employees displaced by the transition to a market economy.
7. Timely and systematic information flows are essential to project success."

Belgium

by F. Carbonnelle, S.A. Engrais Rosier April 1999

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	60
Co-operatives	30
Government outlets	10
Total	**100**

Summary	
Public sector	10
Private sector	60
Co-operatives	30
Total	**100**

3. Forms of deliveries to the first destination

	From the plant	Trend*
Bulk (solid)	86 %	
Palleted bags	4,7 %	
Big bags**	3,9 %	
Fluids	14 %	

* Increase Decrease Constant
** 500 kg

4. Transport to the first destination

Transport to the first destination:

	Road
Bags	100 %
Bulk	100 %

Weighted average distance to first destination:
150 km

5. Fertilizer distribution and the environment

Engrais Rosier S.A. is a member of VAL-I-PAC, a registered organism for the recycling of packages.

Brazil

by M.A. Barbosa Neto, Fertilizantes Serrana S.A. March 2000

The Brazilian fertilizer industry has three basic types of enterprise:

(i) Exclusively producing companies, i.e. those producing a basic raw materials (e.g. phosphate rock), or intermediates (ammonia, sulphuric acid and phosphoric acid) and basic fertilizer manufacturers (MAP, DAP, TSP, SSP, urea, ammonium nitrate).

(ii) Semi-integrated enterprises, which buy in domestic or imported raw materials and intermediates to produce straight, complex and mixed NPK fertilizers.

(iii) Exclusively mixing enterprises, which acquire all their raw materials and intermediates from third parties, only producing NPK mixtures.

The segments which produce and market NPK mixtures, comprising enterprises of the types (ii) semi-integrated or (iii) exclusively mixture producers, have invested, in recent years, in plants with an annual production capacity from 100 to more than 600 thousand tonnes, in an effort to obtain substantial economies of scale.

The fertilizer distribution system in Brazil is strongly based on the logistics of up-grading intermediate fertilizers to produce formulations. The formulations are produced near to producing units for fertilizer raw materials in the case of domestic production, or next to ports in the case of imported fertilizers.

80% of fertilizer distribution is accounted for by the sale of formulations, 65% of fertilizers being sold to rural producers in the form of mixtures of granulated products, of which granulated grades account for 5%, powder formulations for 10%. Straight fertilizers account for 20% of the total market.

Almost all fertilizers are sold in 50 kg bags, with a very small proportion in 1000 kg bags or in bulk. Only a few large rural producers have themselves the necessary infrastructure to handle fertilizers in 1000 kg big bags or in bulk.

60% to 65% of fertilizers are marketed directly by the mixing enterprise to the rural producer, while co-operatives account for 20 to 25% and merchants for scarcely 10% to 15%.

This distribution system permits the delivery of product over long distances, over an average radius of 500 km, relying on road transport and often profiting from return freight by transporting grain from agricultural areas to the exporting ports.

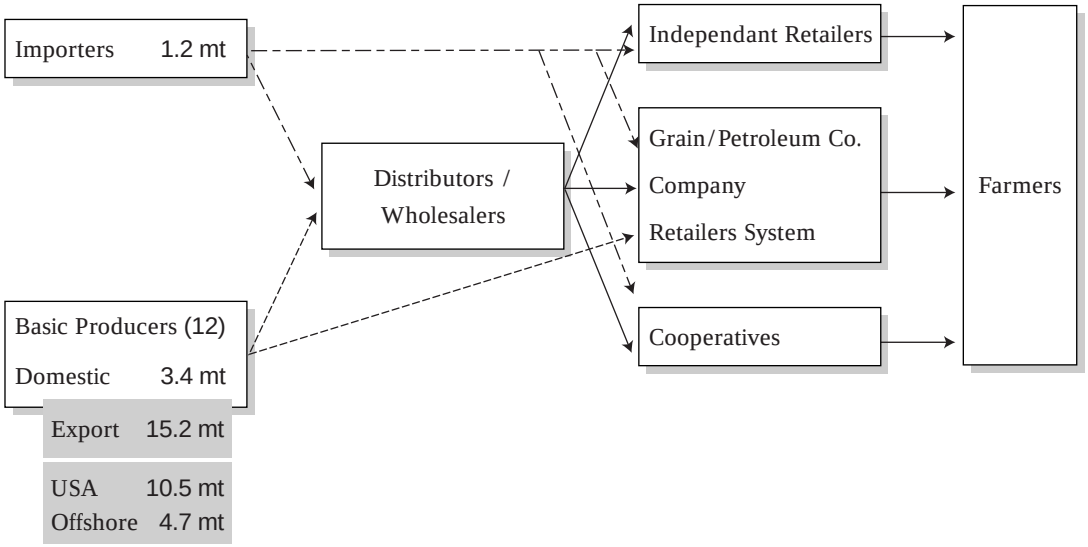
On the other hand, the segment of the fertilizer industry responsible for the marketing of product directly to the rural producer lacks consumer services in view of the weak relationship between the enterprise and the client.

In consequence, the Brazilian rural producers have had to equip themselves with all the structure required for receiving, storing, internal transport and application of fertilizers.

Canada

by R. L. Larson, Canadian Fertilizer Institute May 1995

1. Distribution network



The Canadian fertilizer production and distribution system is shown in the diagram. In most cases the distribution network begins with a producer's plant or a port/terminal with outbound shipments by rail or truck to the producers' offsite warehouses and to a lesser extent by truck direct to dealers' plant. Distribution is generally a direct producer to retailer system although a distributor or wholesaler may sometimes be involved (usually in the case of imports).

2. Sales to the farmers

	% of total retail sales
Independant Dealers	40
Grain or Petroleum company retail systems	35
Co-operatives	25
Total	**100**

3. The main fertilizer distributors

Basic producers, importers, private wholesalers/ retailers, Co-operatives.

China

In China, the distribution of fertilizers is government-controlled. The China National Agricultural Means of Production Corporation (CNAMPGC) and the All China Federation of Supply and Marketing Cooperatives manage the distribution of agricultural inputs. Fertilizers have been sold at fixed prices to farmers. However, increases in distribution costs together with rigid trading and pricing mechanisms have resulted in marketing inefficiencies.

The China National Chemical Import and Export Corporation, Sinochem, is the state-owned import/export trading company in China with a total turnover in 1995 of US$18.2 billion. In 1996, Sinochem imported about 18 million tonnes of fertilizer including 6 million tonnes of urea, 4.5 million tonnes of DAP and 3.5 million tonnes of potash. In 1997, total imports were somewhat lower at 16 million tonnes as urea imports fell away to only 3.5 million tonnes. The China National Agricultural Means of Production Group Corporation (CNAMPGC) (at both national and provincial level) distributed about 83 million tonnes of fertilizer in 1990 and about 105-115 million tonnes in 1996 and 1997.

In 1993, backed by a technical assistance grant from the Asian Development Bank, the Chinese authorities began to develop the legal and regulatory framework to establish a fully market-based fertilizer industry and distribution system. The CNAMP had already lost some of its monopoly on fertilizer distribution and imports were freed up to some extent so that by the end of 1993 Sinochem's share of imports was down to about 70% of the total for both urea and DAP; imports of potash meanwhile were still fully controlled by Sinochem.

Throughout 1994 however, due to a tightening of international supply and demand, market prices of urea and DAP began to rise sharply. Fearing farmer discontent, the government imposed a series of price ceilings on fertilizers. But international prices continued to rise and there were many complaints about the profiteering of the independent traders.

Finally, in September 1994, in an effort to increase central purchasing power, the government reimposed the import monopoly and decreed that all fertilizer imports including those done by the Central CNAMP and the Provincial CNAMPs would be brought together again and handled by SINOCHEM. Import quotas would be allocated by the State Planning Authority. At the same time, domestic fertilizer producers were instructed to sell at least 90% of their output through the AMPC network in each province. The remaining 10% could be sold through other channels at regulated prices monitored by the provincial price committees.

In mid-November 1998, the State Council issued a circular calling on implementation on a new fertilizer distribution system to increase profitability for fertilizer producers and guarantee fertilizer supplies for farmers. The reform has given fertilizer producers the freedom to set prices in line with market fluctuations and to sell products directly to farmers.

In this reform, Sinochem was granted the right to engage in internal trade of chemical fertilizers. CNAMPGC was granted importing rights for chemical fertilizers as well as Sinochem.

The following is an extract from an article which appeared in Fertilizer Focus, May 1999, page 52, by the China National Agricultural Means of Production Group Corporation, CNAMPGC.

CNAMPGC, which is directly affiliated to the All China Federation of Supply and Marketing Cooperatives, is China's only corporation operating on a nationwide basis that specializes in supplying fertilizers, pesticides, plastic sheeting and other agricultural materials.

CNAMPGC first began supplying products to the agriculture sector some forty years ago. Today, its registered capital totals 148 million yuan (RMB) and its fixed assets are valued at one billion RMB. During the past three years, its annual fertilizer turnover has totalled around 10 million tonnes and its annual sales have been around RMB 15 billion.

CNAMPGC is active throughout China. It operates seven wholly owned subsidiaries (located in Shenyang, Tianjin, Shanghai, Guangzhou, Chengdu, Shenzhen and Hainan), 29 offices located in the main ports and at large fertilizer plants and seven large warehouses in the main transit centres of China. The floor area of these warehouses and their storage capacity aggregate to 100,000 square metres and 170,000 tonnes respectively. In addition, CNAMPGC owns 80,000 square metres of open storage, five railway sidings and two piers that can accommodate vessels of 10,000 tonnes capacity. In total, the corporation employs nearly 2,500 people, of which about 135 are located at its Beijing headquarters. These organizations and facilities, coupled with the local agricultural means of production corporations and supply and marketing cooperatives at the grass root level, form an efficient network for product dispatch and distribution.

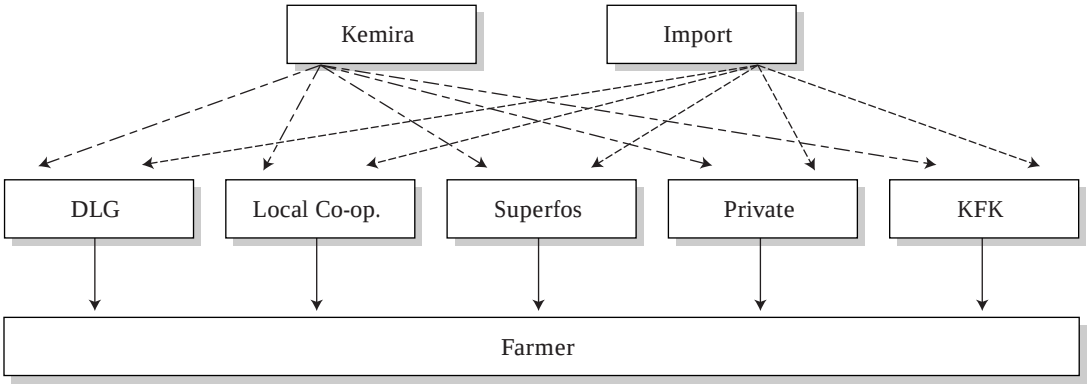
In 1994, the State gave CNAMPGC the right to act as an importer and exporter of a range of products, but excluding fertilizers. However, in November 1998, the State granted CNAMPGC the right to import fertilizer on its own behalf, using the central quota granted to CNAMPGC, and to act as the fertilizer import agent for local fertilizer buyers, enabling CNAMPGC to become a fertilizer-importing channel into China alongside Sinochem. At the time of writing, the immediate and effective preliminary work involved in this expansion of CNAMPGC's role had been completed and the ordering and purchasing of fertilizer for the spring season was well underway. To date, CNAMPGC has already carried out all the activities associated with its new position, including the opening of letters of credit, vessel chartering, insuring the fertilizer cargo to point-of-discharge in China, bagging and selling, experience that will be very useful as this side of its business expands.

CNAMPGC has not concentrated solely on developing its main businesses; it has diversified into other areas, often areas allied to its main activities, as opportunities have arisen. Activities related to its fertilizer activities include 15 fertilizer compaction plants and three bulk blending plants (either wholly owned by the corporation or as joint-ventures) and three bulk fertilizer bagging plants.

Denmark

by Mogens Nielsen, Kemira Denmark May 1995

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	36
Co-operatives	64
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Bulk (solid)	91 %		83 %	
Bulk blends	-		8 %	
Palleted bags	9 %		7 %	
Fluids	1 %			

* Increase Decrease

4. Transport

Transport to the first destination:

	Rail	Road	Water
Bags	40 %	50 %	10 %
Bulk	40 %	50 %	10 %

Weighted average distance to first destination:

100 km	100 km	200 km

Peak distribution months: March, April.

Egypt

by Yosry El Khayat, Abu-Qir Fertilizers & Chemical Ind. Co. May 1999

1. Distribution network

The company has annual contracts with its distributors. The majority are private sector trading companies. They provide the company regularly with their orders destined for their customers all over the country. The company dispatches the orders to the required destinations, generally by trucks and some by railway.

2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	60
Co-operatives	30
Government outlets	10
Total	**100**

Summary

Public sector	10
Private sector	60
Co-operatives	30
Total	**100**

3. Forms of deliveries

		From the plant	To the farmer
Loose	50 kg bags	100%	100%

4. Transport to the first destination

Transport to the first destination:

	Rail	Road	Water
Bags	10 %	90 %	-

Weighted average distance to first destination:

600 km	350 km	-

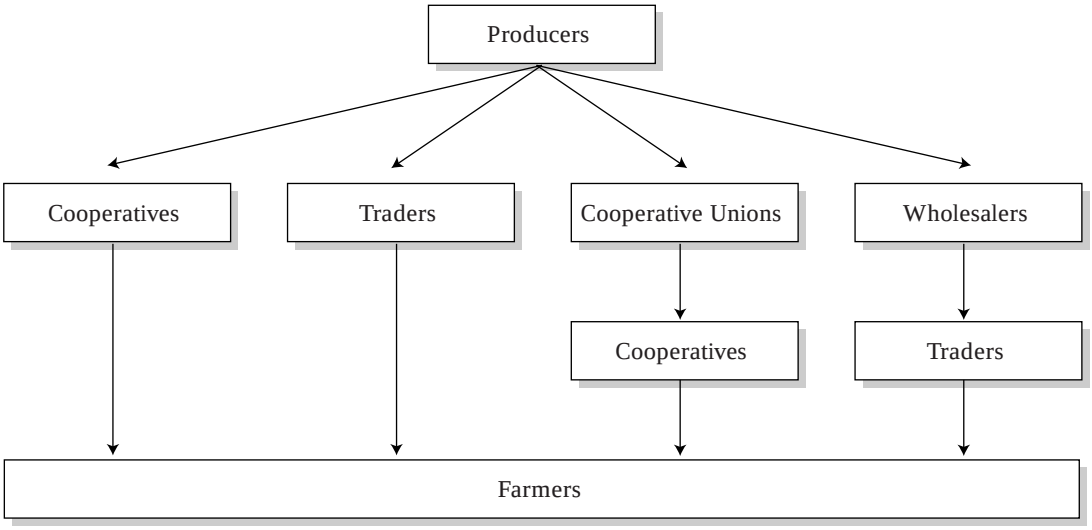
5. Fertilizer distribution and the environment

The company already has the ISO 9002 Quality Management Certificate since July 1996. Now it is going to have the Environment Management Certificate ISO 44001. The company applies strict regulations concerning fertilizers handling. There is no legislation specifically for fertilizer distribution. But the law nr. 48 year 1986 governs all aspects concerning pollution control whether solids, fluids or gaseous.

France

May 1999

1. Distribution network



The distributors, particularly the cooperatives, play an important role and 70% of the advice to farmers is given by the distributors.

2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	45
Co-operatives	55
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Bulk (solid)	52 %		69 %	
Loose bags	2 %			
Palleted bags	25 %			
Big bags	21 %			
N solutions			16%	

* Increase Decrease Constant

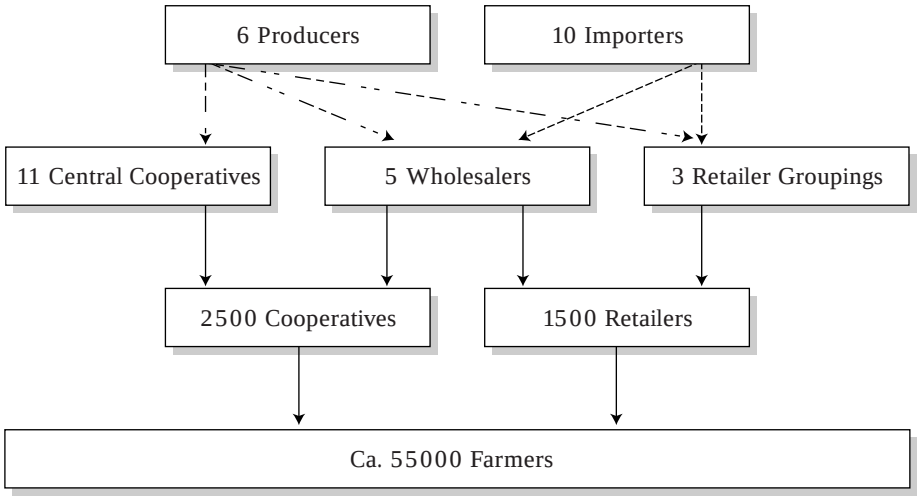
Estimates of **physical losses** of sold fertilizers between the factory or port gate and the farm: 0%.

Peak distribution months: February - April.

Germany

by W. Wichmann, BASF May 1995

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	41
Co-operatives	59
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Bulk (solid)	80 %		80 %	
Bulk Blends	4 %		4 %	
Palleted bags	3 %		3 %	
Fluids	13 %		13 %	

* Increase Decrease

4. Transport

Transport to the first destination:

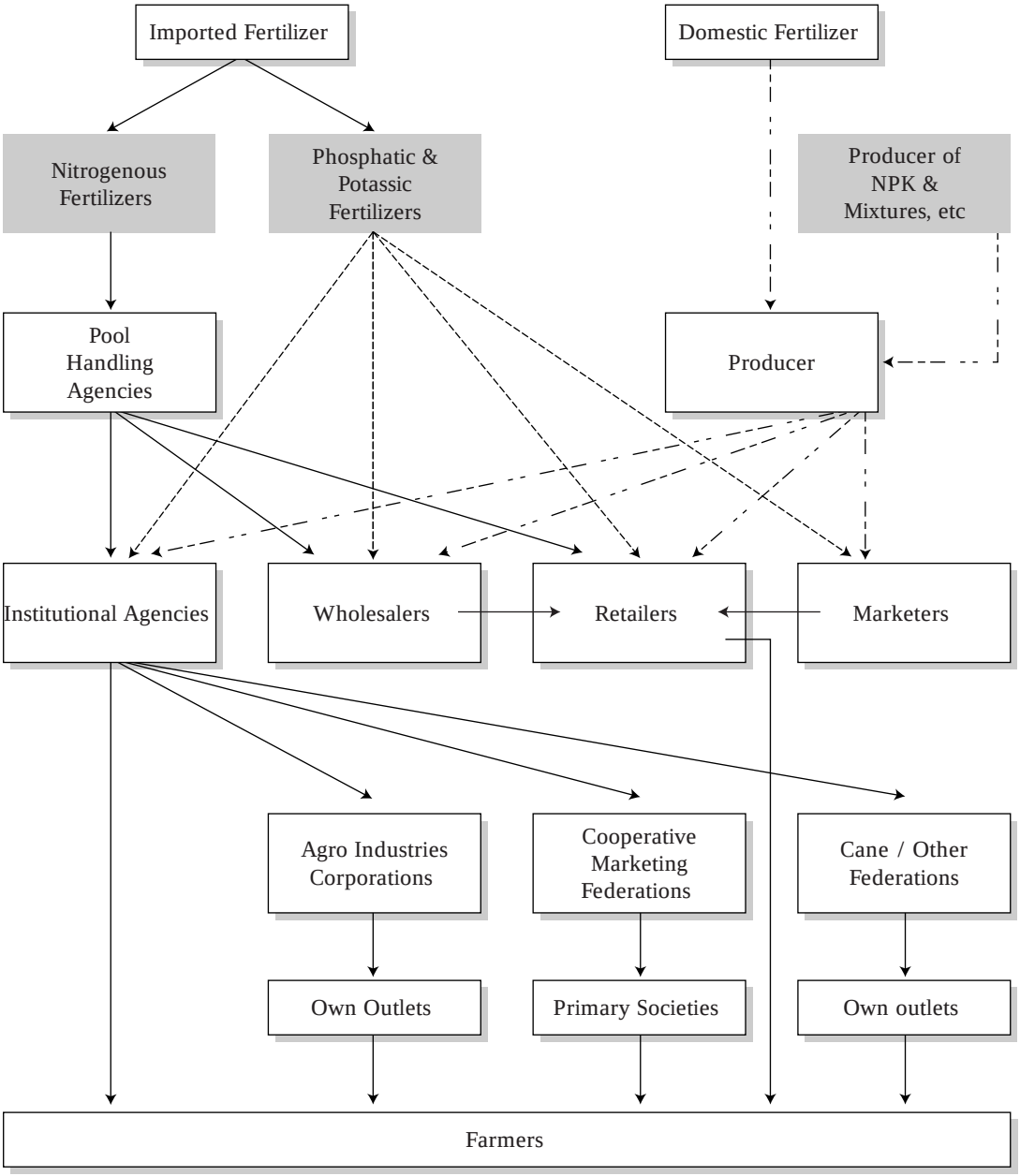
	Rail	Road	Water
Bags	6 %	8 %	-
Bulk	94 %	92 %	100 %
Weighted average distance to first destination:			
	275 km	150 km	n.a.

Peak distribution months: October, November, December, January, March**.**

India

by Pratap Narayan, The Fertiliser Association of India April 1999

1. Distribution network



2. Sales to the farmers

% of total retail sales (1995-96)	
Direct by the producer	negligible
Private wholesalers/retailers	68 %
Co-operatives	32 %
Government outlets	negligible
Total	**100**

Summary*	**Material %**
Public sector	33
Private sector	51
Co-operatives	16
Total	**100**

** Sectorwise sale by fertiliser manufacturers and importers.*

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Loose				
50 kg bags	almost 100 %		almost 100 %	
Fluids	negligible		negligible	

* Increase Decrease

4. Transport to the first destination

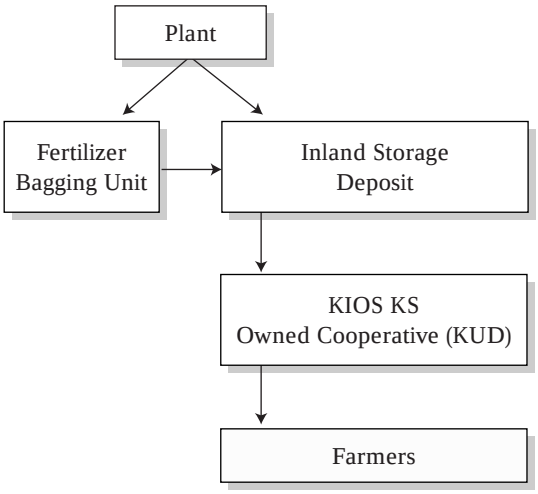
Transport to the first destination:

	Rail	**Road**	**Water**
Bags	70 %	30 %	Nil
Bulk	Nil	Nil	Nil
Weighted average distance to first destination:			
	858 km	378 km	Nil

Indonesia

PT Pupuk Sriwidjaja October 1992

1. Distribution network



PT Pusri as the only distributor of the subsidized fertilizers in Indonesia, uses a system called 'Pipe Line Distribution System' that constitutes the link of distribution from the producer to the consumers.

2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	11
Co-operatives	74
Government outlets	15
Total	**100**

Summary	
Public sector	74
Private sector	26
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Bulk (solid)	63 %			
Bulk blends				
Loose bags	1%			
Palleted bags	17 %		100 %	
Big bags				
Fluids				

* Increase Decrease Constant

4. Transport

Transport to the first destination:

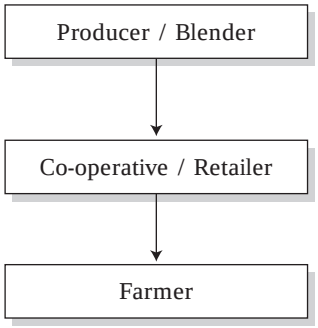
	Rail	Road	Water
Bags	-	76 %	24 %
Bulk	-	-	100 %

Peak distribution months: October - December.

Ireland

by B. Barnes, Irish Fertilizer Industries May 1995

1. Distribution network



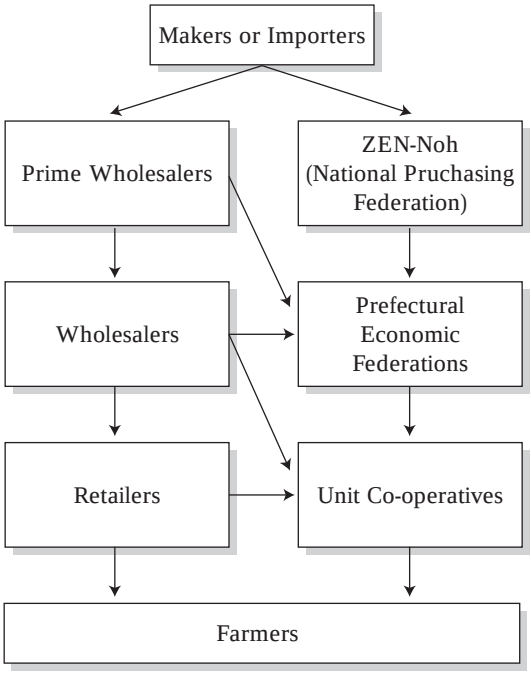
2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	43
Co-operatives	57
Total	**100**

Japan

by T. Muraoka, JUASIA-Japan Urea & Ammonium Sulphate Industry Association April 1999

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	10
Co-operatives	90
Total	**100**

Summary	**%**
Private sector	10
Co-operatives	90
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Loose bags	54 %		100 %	
Palleted bags	39 %			

* Increase Decrease

4. Transport

Transport to the first destination:

	Rail	**Road**	**Water**
Bags	3 %	86 %	11 %

Weighted average distance to first destination:

300 km 200 km 600 km

5. Fertilizer distribution and the environment

There are no particular environmental problem as far as storage and handling are concerned since almost all fertilizers (except raw materials) are in bags.

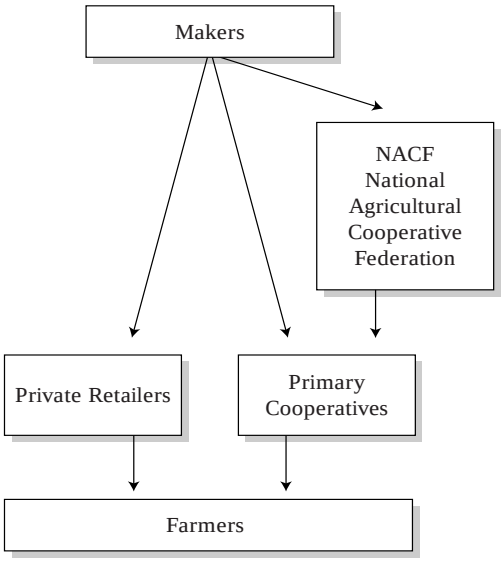
The fertilizer distribution is carried out by co-operatives and private retailers without government regulations.

The most important current issue is the restructuring of the co-operatives' distribution system in, i.e. they are conducting a "merger" of co-operatives so as to enlarge distribution points and to minimize cost of storage, transportation, interest etc.

Korea Republic

by Jeong-Kyu JOO, KFIA-Korea Fertilizer Industry Association January 2000

1. Fertilizer distribution system



In principle fertilizers are traded freely in Korea. Since they are seasonal commodities and are bulky and heavy, fertilizers are dealt with mostly by NACF (The National Agricultural Cooperative Federation) which has large storage facilities nationwide. NACF handled 96% of the products in 1998, private retailers 4%.

Speciality fertilizers for horticulture, liquid fertilizer, by-product fertilizer, soil amendments, are sold by NACF and private retailers in competition.

2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	4
Co-operatives	96
Total	**100**

Summary	
Private sector	4
Co-operatives	96
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Loose bags	2 %		100 %	
Palleted bags	98 %			
* Increase	Decrease			

4. Transport to the first destination

Transport to the first destination:

	Rail	**Road**	**Water**
Bags	25 %	65 %	10 %
Weighted average distance to first destination:	280 km	120 km	220 km

5. Fertilizer distribution and the environment

Fertilizers are packed in bags for distribution, so there are no problems in handling and storage, and no adverse impacts on the environment.

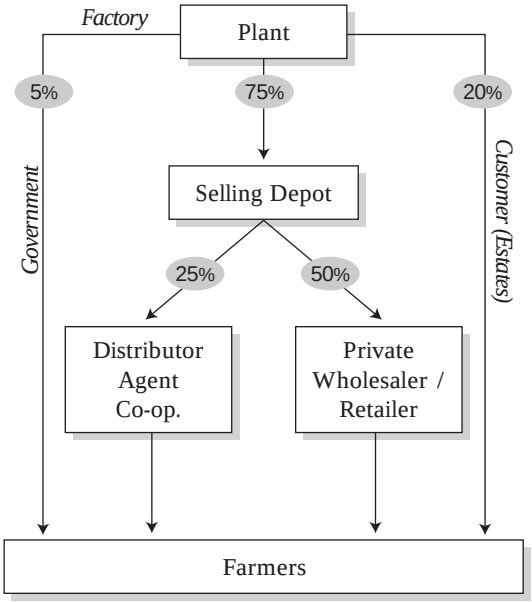
The producers of fertilizers use freight agencies to transport their fertilizers to the storehouses of each local cooperative, and The Korea Express Company which is the largest transportation company in the country, undertakes 87% of the transportation. Other freight agencies carry the remaining 13%.

NACF is trying to reduce the transport costs of fertilizers by establishing a fertilizer pallet pool system by year 2000. In an effort to reduce the expense of the stock management, they plan to reduce stock-holding but not below levels which would be prejudicial to the supply/demand balance of fertilizers.

Malawi

By Alex R.G. Shemu, Norsk Hydro Malawi (Pvt) Limited October 1999

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Direct by the producer	30
Private wholesalers/retailers	50
Co-operatives	10
Government outlets	10
Total	**100**

Summary	
Public sector	10
Private sector	80
Co-operatives	10
Total	**100**

3. Forms of deliveries

Loose bags: 100%

4. Transport

Transport to the first destination:

100 % per road.

Weighted average distance to first destination: 800 km

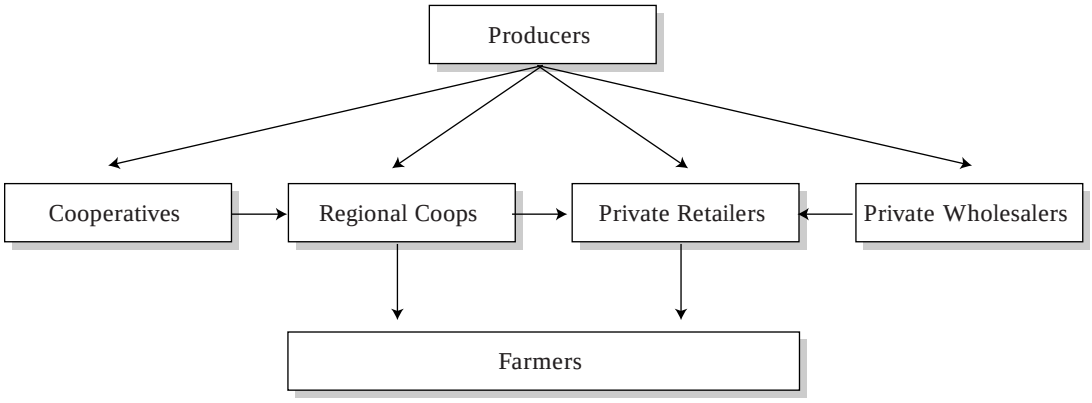
5. Important aspects and requirements

House-keeping, stacking, storage conditions, stock-keeping, handling, protective clothing, separate storage of nitrogen fertilizers, transport including suitable trucks, supervision of loading, unloading and transit. The official quality control of imported fertilizer is needed.

Netherlands

by J. Hakvoort, DSM March 1995

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	55
Co-operatives	44
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Bulk (solid)	98 %		83 %	
Bulk blends	2 %		7 %	
Palleted bags			10 %	
Big bags			1 %	

Estimates of **physical losses** of sold fertilizers between the factory or port gate and the farm: 0%.

4. Transport

Transport from producers to the first destination:

	Rail	Road	Water
Bulk	-	10 %	90 %

Weighted average distance to first destination:

	100 km	150 km

5. Fertilizer distribution and the environment

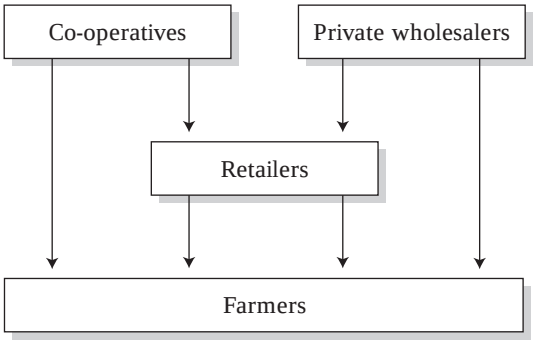
Care is taken that during transport, there is no loss of material affecting the environment. Special care is also taken to store and handle the material scientifically to avoid any seepage, caking, etc. The labourers are advised not to use hooks.

At presently the price, sale, quality and distribution of fertilizers is governed by Fertiliser (Control) Order which came into force in 1957 and has been amended from time to time.

Norway

by R.A. Nordberg, Norsk Hydro AS April 1999

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	24
Co-operatives	76
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Bulk (solid)	56 %		1	
Palleted bags	20 %		39	
Big bags**	24 %		60	
Fluids				

* Increase Decrease Constant
** 600 kg

4. Transport

Transport to the first destination:

	Rail	Road	Water
Bags	-	7 %	33 %
Bulk	-	-	60 %

Weighted average distance to first destination:

	-	200 km	900 km

5. Fertilizer distribution and the environment

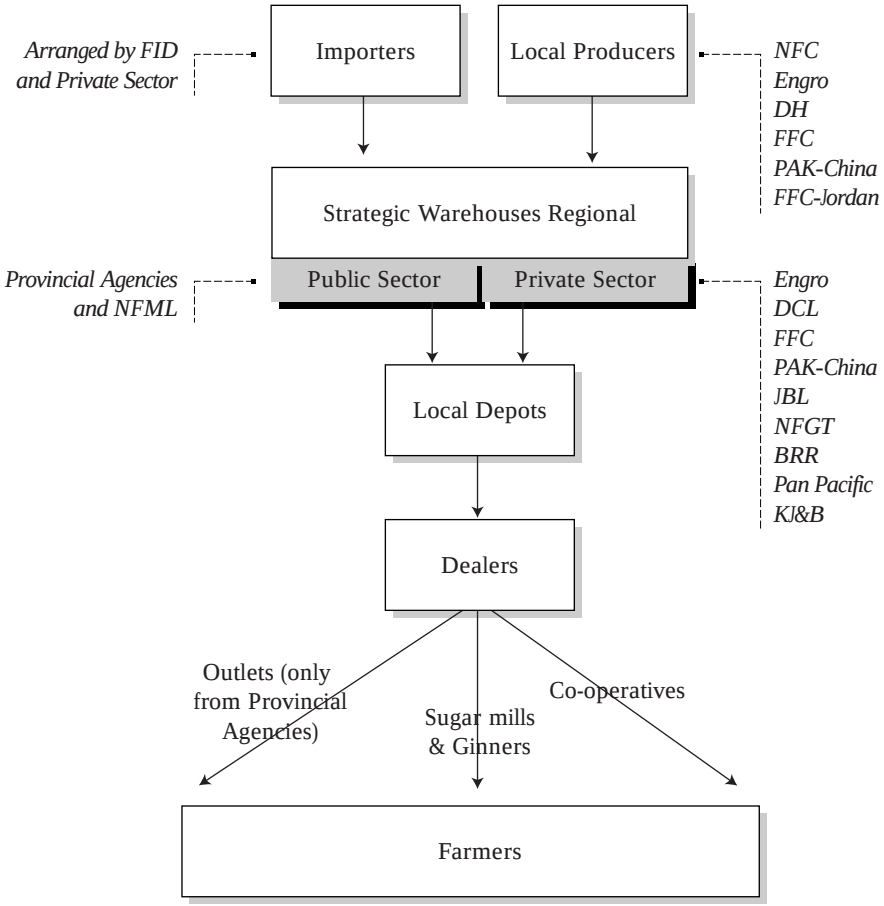
Health, Environment and Safety documents are available to customers and transporters.

Advice on storage and handling is available through information brochures.

Pakistan

by Nisar Ahmad, National Fertilizer Development Centre (NFDC) April 1999

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Direct by the producer	1
Private wholesalers/retailers	85
Co-operatives	7,5
Government outlets	6,5
Total	**100**

Summary

Public sector	31,6
Private sector	66,4
Co-operatives	2
Total	**100**

3. Forms of deliveries

	From the plant	To the farmer
Loose bags	100 %	100 %

4. Transport

Transport to the first destination:

	Rail	Road	Water
Bags	6 %	94 %	-

Weighted average distance to first destination:

440 km	560 km	-

5. Fertilizer distribution and the environment

In private sector Dawood Herculus, Engro Chemical Pakistan Ltd and Fauji Fertilizer Company have obtained ISO-90002 certification. Engro Chemical Pakistan Ltd has completed a project costing Rs. 90 million and after completion of another project worth Rs. 100 million it will fully comply with the National Environment Quality Standards. FFC have made considerable effort and investment to ensure that they are environmentally and ecologically friendly.

Some new importers started to import fertilizers. There is no agency responsible to check the quality and contents required. Fertilizer adulteration is committed by dealers in big markets and during peak demand period. There is a need for legislation but provincial governments are not yet supporting the proposal.

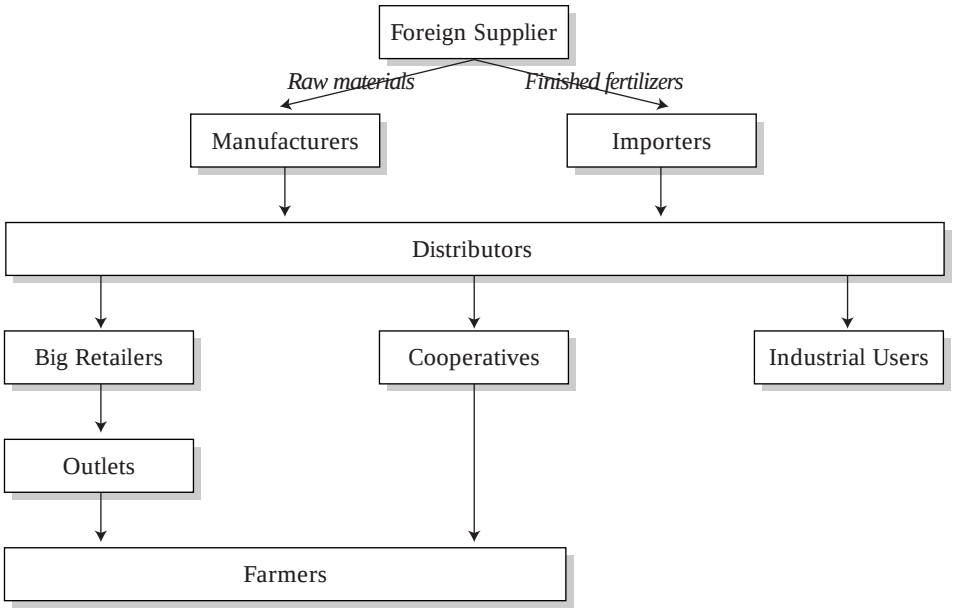
6. Comments

Two new plants: NFC producing 346,000 tonnes of urea and FJFC producing 550,000 tonnes of urea and 450,000 of DAP started production at the end of the year 1998. By this addition, the country will be self-sufficient in respect of urea for the coming 1-2 years.

Philippines

Fertilizer and Pesticide Authority May 1994

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Private wholesalers/retailers	90
Co-operatives	10
Total	**100**

3. Froms of deliveries

	From the plant	To the farmer
Loose bags	100 %	100 %

4. Transport

Transport to the first destination:

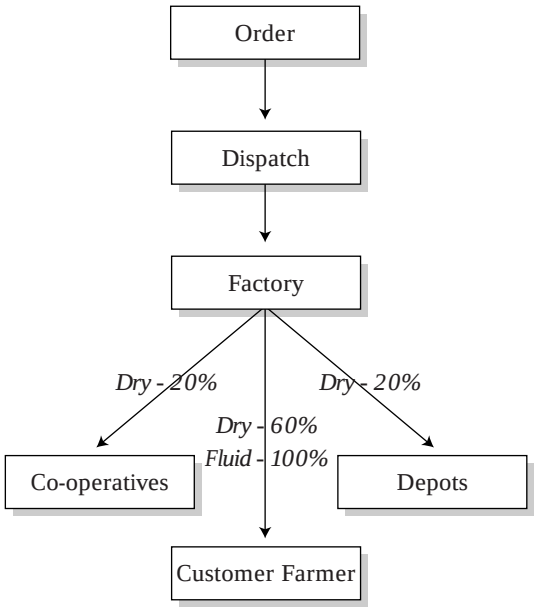
	Rail	Road	Water
Bags	-	-	100 %
Bulk	-	-	100 %

Peak distribution months : May-July and November-January.

South Africa

by J.F. Ranwell, The Fertilizer Society of South Africa October 1992

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Direct by the producer	60
Private wholesalers/retailers	10
Co-operatives	30
Total	**100**

Summary	
Public sector	-
Private sector	100
Co-operatives	-
Total	**100**

3. Forms of deliveries

	To the farmer	Trend
Bulk (solid)	4 %	
Bulk blends	72 %	
Loose bags		
Big bags**	4 %	
Fluids	20	

* Increase Decrease
** 500 kg or more

The most common **bag sizes**: 500 kg.

Estimates of **physical losses** of sold fertilizers between the factory or port gate and the farm: Negligible.

4. Transport

Transport to the first destination:

	Rail	Road	Water
Bags	30 %	70 %	-
Bulk	-	100 %	-

Peak distribution months:

Summer crops: August-September to November-December.

Winter crops: February to April.

The following text is extracted from a paper by Dr. J.B. Skeen, former Managing Director of Kynoch Limited, published in the 1999 Journal of the Fertilizer Society of South Africa, FSSA.

"The dissemination and application of the research based agricultural technical knowledge generated from many quarters contributed hugely to the development of a commercial farming industry that made South Africa one of the elite few net exporters of food in the world. Naturally there were major limitations to the application of this vast, high quality data the most important of which was that the small rural farmer did not share in its benefits. Private business could not profitably service underdeveloped rural areas as costs far exceeded benefits to shareholders. While most of the data and principles arising from agricultural production research is directly applicable and adaptable to underdeveloped rural farming situations, the dissemination thereof, which is an education and promotion problem, is where the focus of resources has to be made in future. Agricultural development and growth among small scale and resource poor farmers requires a major effort to provide adequate extension services to these people. Because of the low cost benefit ratio, these farmers will have to rely heavily on Government funded extension services. Private industry will probably continue to pay only lip-service to fulfilling this need unless tax or other incentives are put in place to justify the cost. Regrettably over the last 10 years State controlled extension services have virtually collapsed as a value-adding organization. It has deteriorated into a high cost institution with no benefit to its customers, the farmers. The deployment of Government extension officers among commercial farmers is now almost non-existent while those operating in former homelands are poorly trained and have little impact on agricultural development. A major challenge to the Department of Agriculture and also to the input industry is to innovatively create an effective extension system that adequately services underdeveloped rural situations.

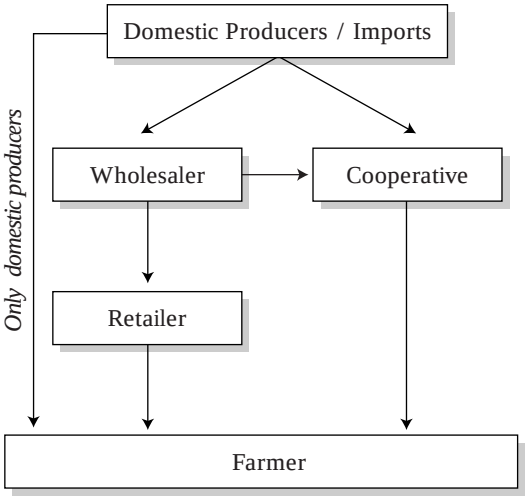
Simultaneously with the demise of State agricultural extension services there has been a critical downsizing in research, development and extension effort at universities, co-operatives and the private sector. In the case of universities the cutback has been as a result of reduced funding from the State. Emphasis is now placed on the need for research to be partially self-supporting. Insofar as co-operatives are concerned, the 'raison d'être' of many of these organizations has changed and will doubtless continue as an increasing level of local and international competition has forced them to rethink their structures and activities. Take-overs and mergers in this sector are expected to increase as their viability becomes threatened by competitive forces and many are unwilling, indeed unable, to support the costs of many services, including agricultural advisory services.

A similar development is beginning to take hold in the fertilizer industry to the detriment of the farming community and the agricultural industry as a whole. In an endeavour to remain competitive, local fertilizer manufacturers are having to trim overhead costs to maintain a competitive cost position against the predatory effects of opportunist importers. These suppliers have been taking advantage of current low international prices to undercut the activities of domestic producers. Their products are supplied to the farming industry at margins that are not required to cover the broad range of services traditionally offered by local producers which includes agricultural technical support. The consequence has been a decline in the availability of research and technical service previously supplied to customers as part of a marketing mix. Ironically, however, in a world where price wars and product parity have turned competition into an endless round of pit-bull fights it will not be feasible in the long run to make money with products alone anymore. Companies are being positioned in developed agricultural economies not simply as sellers of products but as providers of services. Added value comes from helping customers farm efficiently by applying the correct combination of quality fertilizer, inter alia, at the right time. The successful dealer of the future is one that will remain ahead of customer needs and who, in their turn, will demand more added value for their money. This added value does not only include technological developments and other advisory services although it is a major part of it. Under present circumstances the local fertilizer industry is becoming hard-pressed to reward shareholder investment while still providing a full range of customer services. Regrettably free trade is turning many agricultural input industries into sellers only and not producers of services. This situation presents itself at a time when farmers are beginning to cry out for greater technical assistance as they themselves grapple with uncontrolled competition in the marketing of their products."

Spain

by J. Pardo, Fertiberia SA June 1999

1. Distribution network



Note on Fertiberia's Services

Fertiberia offers a full range of services, aimed at improving the professionalism and efficiency of the network, as well as giving technical and professional assistance to Spanish agriculture.

Fertiberia also provides training for the accredited dealers. There is training in the agronomy of fertilizers and sales techniques for the salesmen, and also in management techniques. The dealers have the services of five Fertiberia agronomists. The dealers also have agronomists, some 30 to 35 in all.

Soil, leaf and water analysis services are offered free-of-charge. The analyses are carried out at Fertiberia's Huelva plant. At present some 12000 analyses are carried out annually, the capacity being 30000 p.a. Fertiberia is the only fertilizer company in Spain to offer this service.

2. Sales to the farmers

	% of total retail sales
Direct by the producer	2
Private wholesalers/retailers	54
Co-operatives	44
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Bulk (solid)	87 %		55 %	
Loose bags	2 %		15 %	
Palleted bags	7 %		23 %	
Fluids	4 %		7 %	

* Increase Decrease Constant
** kg

4. Transport

Transport to the first destination:

	Rail	Road	Water
Bags	1 %	8 %	-
Bulk	6 %	94 %	-

(includes important products)

Weighted average distance to first destination:

400 km	300 km	-

5. Fertilizer Distribution and the Environment

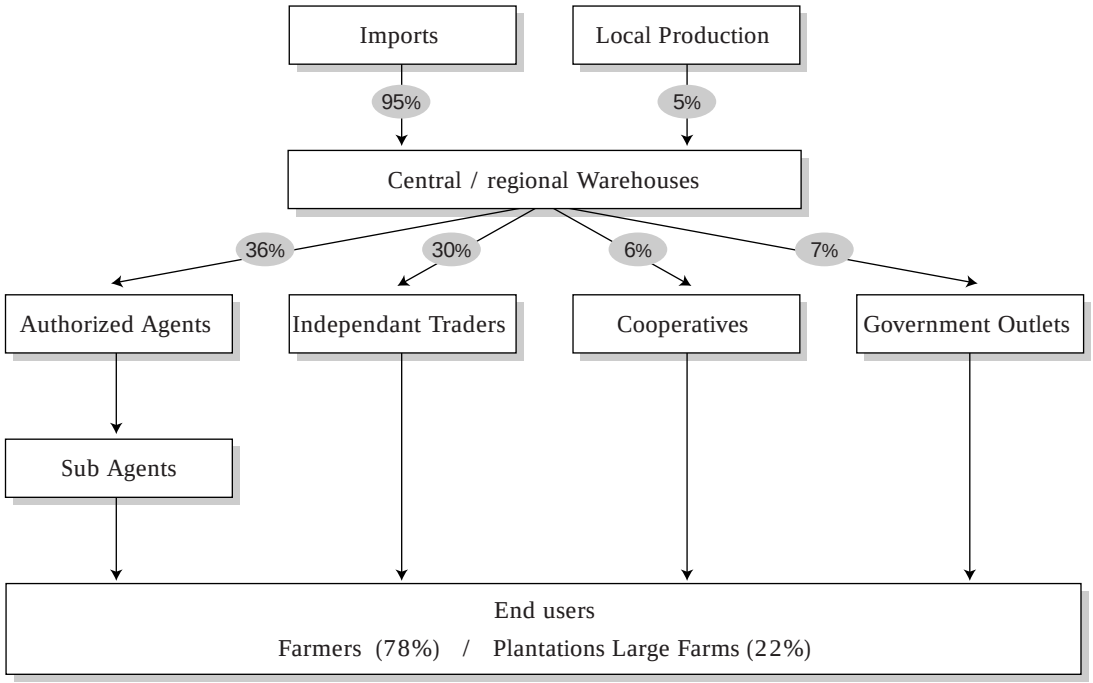
Solid nitrogen fertilizers with 20% N or above must meet the TPC standards and fulfill specific storage regulations.

Liquid fertilizers must be stored in tanks made of specific materials to avoid corrosion. Some of them are specifically built to meet different security regulations.

Sri Lanka

by D.R. Wijayatilleke, National Fertilizer Secretariat March 1993

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Direct by the producer	22
Private wholesalers/retailers	65
Co-operatives	6
Government outlets	7
Total	**100**

Summary	
Public sector	31
Private sector	69
Total	**100**

3. Forms of deliveries

	From the plant	To the farmer
Loose bags	100 %	100 %

The most common **bag sizes**: 50 kg, 25 kg, 10-5 kg.

4. Transport

Transport to the first destination:

	Rail	Road	Water
Bags	10 %	90 %	-
Bulk	-	-	-

Weighted average distance to first destination:

10 km	-	-

Peak distribution months:

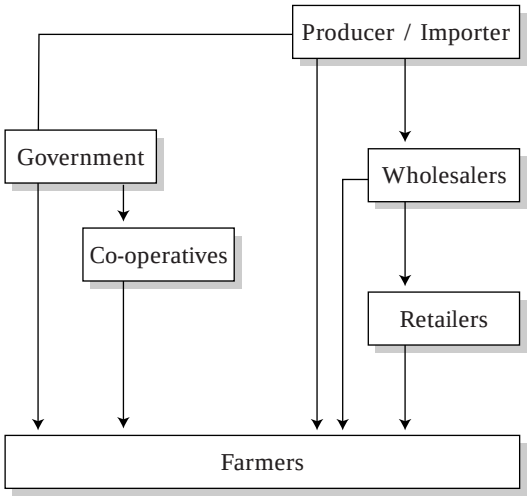
October - January (Maha season)

June - July (Yala season)

Thailand

by Kaboon Sakulyong, Thai Central Chemical Public Co., Ltd. April 1999

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Direct by the producer	10
Private wholesalers/retailers	65
Co-operatives	15
Government outlets	10
Total	**100**

Summary	
Public sector	10
Private sector	75
Co-operatives	15
Total	**100**

3. Forms of deliveries

	From the plant	To the farmer
Loose bags	100 %	100 %

4. Transport

Transport to the first destination:

	Rail	Road	Water
Bags	-	95 %	5 %

Weighted average distance to first destination:

-	400 km	700 km

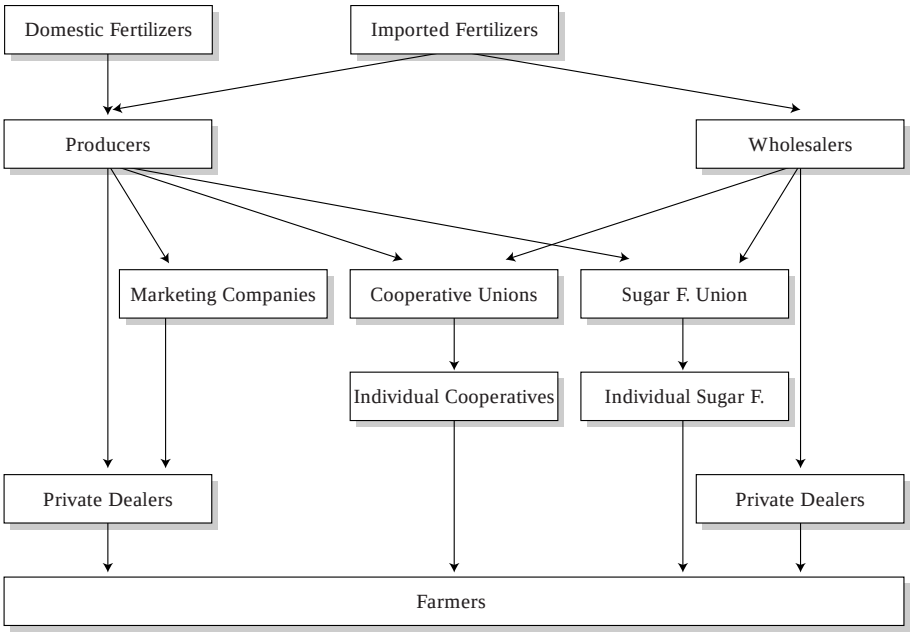
5. Fertilizer distribution and the environment

- Almost all fertilizers are packed in 50 kg water-proof strong plastic bags. Producers have to print the registration numbers of the fertilizer with nutrient content and crop on which they are to be applied on the bags, which are strictly controlled by government officers.
- The fertilizer warehouses of producers, importers and wholesalers also have to be registered.
- Wholesalers and retailers of fertilizers have to be registered with the government.
- Government give tax and VAT exemption for fertilizers business.
- The Domestic Trade Department is controls the retail prices of fertilizers.

Turkey

by S. Bayraktar, Toros Fertilizer and Chemical Industry May 1999

1. Distribution network (1998)



Fertilizers are distributed by producers and importers through their dealership, organizations, cooperatives and agricultural crop processing organizations (such as sugar factories, canning industries, etc.)

2. Sales to the farmers

	% of total retail sales
Direct by the producer	31
Private wholesalers/retailers	33
Co-operatives	32
Government outlets	4
Total	**100**

Summary	
Public sector	22
Private sector	46
Co-operatives	32
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Loose bags	100		100	

* Increase Decrease Constant

Estimates of **physical losses** of sold fertilizers between the factory or port gate and the farm: 0.2 %.

4. Transport

Transport to the first destination:

	Rail	**Road**	**Water**
Bags	3 %	90 %	7 %

Weighted average distance to first destination:

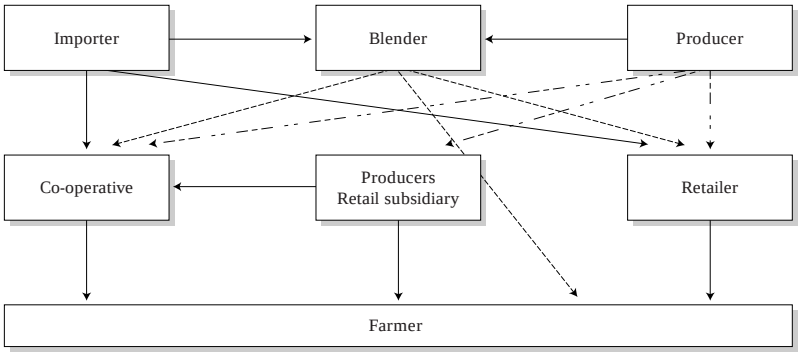
500 km	250 km	1500 km

Peak distribution months:
September - November, February - April.

United Kingdom

by D. Heather, Fertilizer Manufacturer's Association July 1999

1. Distribution network



2. Sales to the farmers

	% of total retail sales
Direct by the producer	18
(including retail subsidairies)(incl. fluids and blends)	
Private wholesalers/retailers	62
Co-operatives	20
Total	**100**

Summary	
Private sector	80
Co-operatives	20
Total	**100**

Note: Private wholesalers/retailers and co-operatives have the same function (UK co-ops have a different structure and purpose to those in eg. France and Germany)

3. Forms of deliveries

	From the plant	Trend*
Palleted bags	10 %	
Big bags**	74 %	
Fluids***	16 %	

* Increase Decrease

** The most commun bag size: 90 % +500 kg

*** combined (and including deliveries to blenders)

4. Transport

Transport to the first destination:

	Rail	Road
Bags	2 %	98 %
Bulk	-	100 %

Weighted average distance to first destination:

300 km 170 km

5. Fertilizer distribution and the environment

Major manufacturers have their own codes of practice for this purpose.

Other codes are available from the UK's Health and Safety Executive.

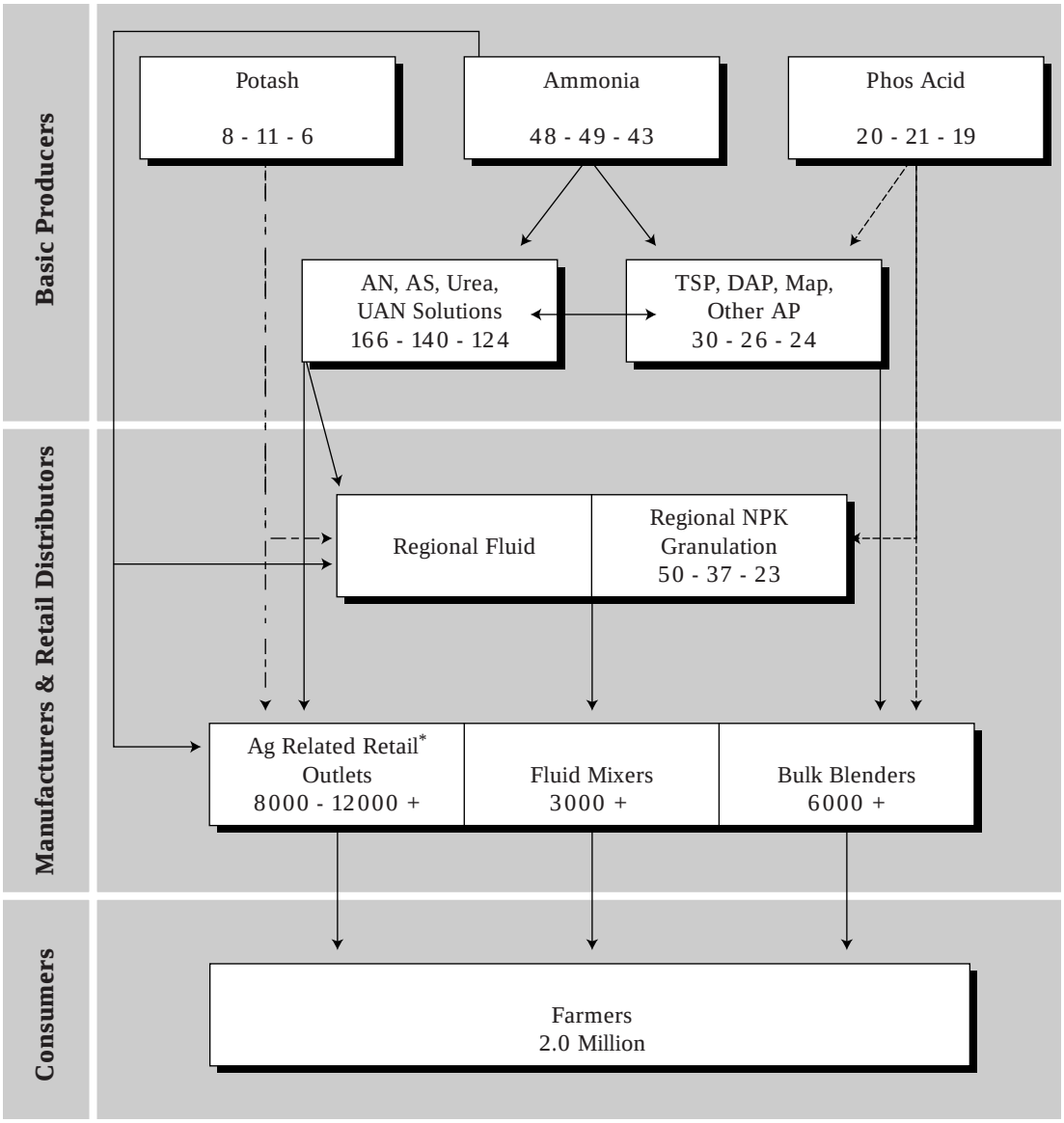
6. Brief information on recent or proposed legislation/regulations relevant to the fertilizer distribution

The carriage of Dangerous Goods by Road Regulations 1996.

United States

by Scott Simpson, International Fertilizer Development Center April 1999

1. Distribution Network



Numbers represent operating plant locations - Fertilizer Year 1988, 1992 and 1999.
** . IFDC estimates the total retail outlets selling fertilizers in bag or bulk for farm or non-farm uses to be in excess of 17000 based on 1998 survey data.*

Raw materials flow from the basic producers and/or regional dry/fluid producers to retail fertilizer dealers who, in turn, sell these fertilizer materials to approximately 2.0 million farmers. The consensus is there are between 8,000 and 12,000 retailers that actually blend or mix fertilizer materials at retail agribusiness locations for distribution to the agricultural sector. However, IFDC estimates, based on a 1998 survey, there are in excess of 17,000 outlets where fertilizer materials are actually sold in bag or bulk for both agricultural and non-agricultural purposes.

2. Sales to farmers

Data for this topic was last obtained in 1992 by TVA and has not been collected since that time. After discussions with several in the U.S. industry, the feelings were the old numbers may still be fairly reflective of today's distribution percentages; however, since no accurate data exists, the U.S. numbers should be shown in a range.

	% of total retail sales
Direct by the producer	<3
Private wholesalers/retailers	55-65
Co-operatives	35-45
Total	**100**

Summary	
Private sector	100

2. Forms of Deliveries (1998 Consumption Data)

Trends indicate that dry bulk products have been increasing relative to fluids and dry bagged products for the past several years. Dry bagged products have been decreasing over time; however, this market should stabilize at or near current levels based on a relatively stable lawn and garden market. The fluid market, with increasing long-term trends, has stabilized the past 4 to 6 years.

3. Transportation

	From the plant
Dry bulk (solids/blends)	54 %
Fluids *	39 %
Dry bagged	7 %

* Including mixtures, anhydrous ammonia,

Four transportation modes are used in the United States: barge, rail, truck and pipelines for the transport of ammonia. Initial movement of dry bulk fertilizer materials from basic production locations is primarily by barge or rail with movement by barge the mode of choice because of its lower transportation cost. There are 18 States which border the inland waterway system in the United States. Fertilizer consumption in these States accounts for over 70% of the total consumed. It is therefore reasonable to assume a substantial portion of U.S. fertilizer is initially transported by barge. Transportation to the retail agribusiness site is usually by rail or truck depending on the retailers geographic location.

There are two major ammonia pipelines that transport product from major producing areas to major use areas. The first extends from the Panhandle of Texas to Minnesota and the second from Louisiana to Nebraska. Product is stored in terminals along the pipelines and then moved by rail or truck to retail agribusiness sites.

4. Fertilizer Distribution and the Environment

Information demonstrating the fertilizer industry's concern for safety and the environment during the storage, handling and transport of mineral fertilizers:

There are specific regulations under OSHA 1910.111 for the safe storage and handling of anhydrous ammonia. USDOT regulates all hazardous materials in transport, and as a result, the fertilizer industry must placard vehicles, maintain shipping papers, and other marking requirements. In addition the fertilizer industry

must train employees for hazardous materials handling under USDOT regulations. USEPA, under the Clean Air Act, Section 112r requires risk management plans and programs for anhydrous ammonia facilities. The industry also has a voluntary "Be Aware For America" program aimed at monitoring the distribution and sale of ammonium nitrate in the U.S.

5. Brief information on recent or proposed legislation/regulations relevant to fertilizer distribution

Currently there are several proposed regulations at DOT that would affect fertilizer distribution. An increase in the hazardous material registration fee, requirements for inspection, and maintenance of vehicles has just been finalized by DOT. Fertilizer distribution has experienced some recent problems involving the theft of anhydrous ammonia for illicit drug manufacture. There have been some regulatory proposals put forth that would require facilities to increase perimeter security at the State level.

Zimbabwe

by R.J. Gaiger, ZFC Limited April 1999

1. Distribution network

ZFC Limited has two factories in Harare at which it drymixes and granulates powdered raw materials into a range of NPK compounds. AN, MOP, SOP and SSP are also sold as straights. It employs 30 technical sales representatives who sell directly to the end user. Twenty representatives service the commercial (large scale) farming sector and ten representatives service the Small Scale (peasant) sector. About 20 000 tonnes blended NPK's are also produced and sold.

2. Sales to the farmers

	% of total retail sales
Direct by the producer	92
Private wholesalers/retailers	7
Co-operatives	1
Total	**100**

Summary	
Private sector	99
Co-operatives	1
Total	**100**

3. Forms of deliveries

	From the plant	Trend*	To the farmer	Trend
Bulk blends *(50 kg bags)*	8 %		8 %	
Loose bags *(50kg bags)*	91 %		91 %	
Big bags**	1 %		1 %	

Note:Trends are very gradual

* Increase Decrease

** Most commun bag size: 500 kg

4. Transport

Transport to the first destination:

	Rail	Road
Bags	35 %	65 %

Weighted average distance to first destination:

150 km 120 km

5. Fertilizer distribution and the environment

The main problems are the reduction and control of dust generation and emission and the containment of contaminated run-off water during the rainy season.

Legislation on pollution in general exists but is seldom enforced. It does not contain specific references to the fertilizer industry. A new Environment Act has been drafted and is more specific with regard to industries which can be a source of pollution.

About IFA and UNEP

IFA - International Fertilizer Industry Association

IFA, the International Fertilizer Industry Association, comprises around 500 member companies world-wide, in over 80 countries. The membership includes manufacturers of fertilizers, raw material suppliers, regional and national associations, research institutes, traders and engineering companies.

IFA collects, compiles and disseminates information on the production and consumption of fertilizers, and acts as forum for its members and others to meet and address technical, agronomic, supply and environmental issues.

IFA liaises closely with relevant international organizations such as the World Bank, FAO, UNEP and other UN agencies.

IFA's mission

- To promote actively the efficient and responsible use of plant nutrients to maintain and increase agricultural production worldwide in a sustainable manner.
- To improve the operating environment of the fertilizer industry in the spirit of free enterprise and fair trade.
- To collect, compile and disseminate information, and to provide a discussion forum for its members and others on all aspects of the production, distribution and consumption of fertilizers, their intermediates and raw materials.

28, rue Marbeuf
75008 Paris, France
Tel: +33 153 930 500
Fax: +33 153 930 545 /546 /547
E-mail: publications@fertilizer.org
URL: http: www.fertilizer.org

UNEP - United Nations Environment Programme

The Production and Consumption Unit of UNEP DTIE in Paris was established in 1975 to bring industry, governments and non-governmental organizations together to work towards environmentally-sound forms of industrial development. This is done by:

- Encouraging the incorporation of environmental criteria in industrial development.
- Formulating and facilitating the implementation of principles and procedures to protect the environment.
- Promoting the use of low- and non-waste technologies.
- Stimulating the worldwide exchange of information and experience on environmentally-sound forms of industrial development.

This Unit has developed a programme on Awareness and Preparedness for Emergencies at Local Level (APELL) to prevent and to respond to technological accidents, and a programme to promote worldwide Cleaner Production.

39-43, Quai André Citröen
75739 Paris Cedex 15
France
Tel: +33 1 4437 1450
Fax: +33 1 44 37 1474
E-mail: unep.tie@unep.fr
URL: http:www.uneptie.org