Fertilizer industry profile

- Achievements
  - The industry has made significant efforts to develop and adopt new technologies that have significantly reduced emissions from fertilizer production.
  - The industry has been instrumental in getting distributor and adviser certification schemes off the ground in some countries.
  - Leading fertilizer associations and research organisations are involved in research and training to improve the efficient use of plant nutrients.

- Unfinished business
  - Internal knowledge and technology transfer will help all fertilizer production facilities come up to the levels set by industry leaders.
  - The fertilizer industry's safety record is among the best of the chemical-related sectors, but continual improvement is an absolute imperative.
  - The industry's community and stakeholder relations have developed significantly in recent years, but more can be done globally.

- Future challenges
  - As commodity products, most fertilizers currently have little in-built technology to enhance the efficiency of nutrient uptake.
  - More research is needed on removing naturally occurring impurities from fertilizer raw materials.
  - The fertilizer industry faces the challenge of more fully engaging its traders and retailers in efforts to address sustainability issues.

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Industry as a partner for sustainable development

Fertilizer Industry

International Fertilizer Industry Association (IFA)

Developed through a multi-stakeholder process facilitated by: UNEP

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Disclaimer
In a multi-stakeholder consultation facilitated by the United Nations Environment Programme, a number of groups (including representatives from non-governmental organisations, labour unions, research institutes and national governments) provided comments on a preliminary draft of this report prepared by the International Fertilizer Industry Association (IFA). The report was then revised, benefiting from stakeholder perspectives and input. The views expressed in the report remain those of the authors, and do not necessarily reflect the views of the United Nations Environment Programme or the individuals and organisations that participated in the consultation.

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Part I: Introduction

Preface

This document is not really complete and probably could never be so. Understanding of sustainable development evolves constantly. So much effort goes into addressing these issues that we could not possibly cover it all in so few pages, and new projects are being launched at least weekly. However, behind this flurry of activity, there is a relentless march forward.

The industry should be particularly proud of its record on the production side. Efficiency is in some cases reaching theoretical limits. Social issues have received increasing attention.

The fertilizer industry remains concerned about the effects of its products even after they leave the factory gate, and it began promoting efficient and balanced use long before most industries were adopting life cycle product responsibility. In theory, as many as two billion farmers could use fertilizers on any given day. Ensuring that they have the best agronomic information, quality fertilizers and appropriate and efficient technology is a daunting task. However, under-use, over-use or unbalanced use all unleash negative impacts that must be eliminated to achieve truly sustainable production of quality food.

Technology has a role to play, but capacity-building is probably the most important factor. Managing these key agricultural inputs on a global scale requires mobilisation of industry, international organisations, governments, scientists, educators and trainers, farmers, agricultural workers, non-governmental organisations (NGOs) and local communities, all working together.

Although the research to prepare this report revealed much progress, a number of challenges remain.

This report is the first attempt of its kind to look at the contribution of the fertilizer industry to sustainable development, and to consider the challenges that face the industry as regards sustainability. Material from across the globe was reviewed, and we are grateful to the numerous organisations that provided information.

Invaluable stakeholder input was contributed by Mahmood Ahmad (Federation of Pakistan Chambers of Commerce & Industry), Jingen Cheng (Ministry of Agriculture, China), Arend Hoogervorst (Eagle Environmental Consulting), Bob Pagan (Cleaner Production Group), Richard Perkins (WWF), Rudy Rabbinge (Wageningen University & Research Centre), Heino von Meyer (OECD) and Bill Vorley (IIED). Keith Isherwood and Dianna Rienstra assisted in drafting and editing the report. UNEP, of course, played the invaluable role of facilitator and its support has been substantial.

Sincerely,
L M Maene
Director General,
International Fertilizer Industry Associations (IFA)

Executive summary

Imagine the world 50 years from now. World population has stabilised. What will be the major role of mineral fertilizers? What does the world fertilizer industry need to do to become sustainable in the long term after that date? In this context, sustainability can be viewed as having two parts.

How can the mineral fertilizer industry and its products support the sustainable development goals of the wider community?

1. By contributing to food security on a local level, thus contributing to poverty alleviation and human development.
2. By helping prevent and correct soil degradation to meet global environmental objectives such as combating desertification.
3. By ensuring that negative environmental impacts of fertilizer production and use are eliminated where possible and otherwise minimised.

What measures need to be taken by the industry to ensure that mineral fertilizers are produced and used in ways which contribute to those objectives?

1. Development of improved products with greater nutrient efficiency.
2. Processes which remove unwanted impurities and, where possible, identification of new uses which turn these waste products into valuable resources.
3. Working to ensure that the entire fertilizer value-chain, down to retailers, is involved in capacity-building to enable correct use of fertilizers.
4. Ongoing training and capacity-building of farmers and their organisations;
5. Further development of stakeholder relationships.

It is clear that the industry must develop better, value-added products and services to help meet the major challenges posed by sustainability. The industry must establish a pattern of minimal losses, maximum efficiency and maximum recycling. Today is not too early to start imagining this future and the shifts that need to occur to realise this vision.

More research and product development are key. Farmers must receive better training in the use of fertilizers, but how? By whom?

This report seeks to put fertilizers in context today, discuss ways that the fertilizer industry has moved towards sustainability and, most importantly, highlight ways to move forward toward a vision of sustainability.

Part 2: Putting the mineral fertilizer industry into the sustainable development context

A brief overview

An FAO definition of sustainable agricultural development is: 'The management and conservation of the natural resource base, and the orientation of technological and institutional change, in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Such development... conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable.' [Loftas, 1995]

Are mineral fertilizers necessary for this purpose? Professor Vaclav Smil of the University of Manitoba has made the calculations and writes: 'If we were to provide today's average per capita food supply with the 1900 level of agricultural productivity, we could feed only about 2.4 billion people,' and 'Nitrogen fertilizers provide the protein requirements of 40% of the world's population.' [Smil, 1999, pp. 10-11] The same author has written: 'We know that even the most assiduous recycling of inorganic wastes combined with crop rotations, including leguminous crops and green manures, cannot supply more than 120-150 kg N/ha in highly intensive traditional cropping. Such agroecosystems can produce around 200 kg of protein per hectare and feed at least ten to 11 people on largely vegetarian diets. In contrast, today's most productive agroecosystems yield around 800 kg of protein per hectare in multicropped fields receiving high applications of inorganic nitrogen.' [Smil, 2001]

Evidently maximum use should be made of materials such as organic manures before mineral fertilizers are applied. Mineral fertilizers are then needed to supply the remainder of the crop's nutrient requirements, the main nutrients being nitrogen, phosphate and potash.

There is ample evidence that mineral fertilizers are in no way inferior to organic manures as suppliers of nutrients, and in some ways they are superior. Some people believe that mineral fertilizers reduce soil organic matter, whereas they can actually increase it, due to the larger quantity of crop residues. Organic manures and mineral fertilizers complement each other, particularly under certain tropical conditions.

Organic farming is another, separate issue. Work in the UK [Leake A, 1999] has demonstrated that organic farming gives wheat yields about 60% to 70% of conventional systems. This can be compensated by subsidies and the price premium for such products. There is a good market for such products where people can afford to pay the price, but on a global basis a reduction in food production of much less than 30% to 40% would lead to starvation in the poorer countries of the world.

The fertilizer industry is far from being a monopoly of monolithic companies from developed countries. Until the 1960s, its development was indeed in the developed countries of Europe, North America and Japan. However, in the 1970s and early-1980s, the construction of new nitrogen fertilizer plants shifted to the gas-rich countries of the Soviet Union, Caribbean and Near East and to some large consuming countries such as China, India, Indonesia and Pakistan.

During the same period there was a trend towards the processing of phosphate rock in

countries with substantial natural resources of this material, especially in North Africa and the United States, but also in the Near East and South and West Africa. Potash is produced mainly in the few countries where the major ore deposits are located.

As a result of these trends phosphate and potash production is concentrated in a few countries, nitrogen less so since the materials required for its production, atmospheric nitrogen and energy, are universally available.

Over the past 40 years technological progress has resulted in the practical size of ammonia and nitrogen plants increasing by a factor of five or more. Integrated phosphate mining and processing offer significant technical and economic advantages. Economies of scale have led to gradual elimination of small fertilizer plants, mergers and consolidation.

In western Europe a massive restructuring of the fertilizer industry and a large number of mergers and acquisitions took place from 1980 onwards. Since 1983, the number of people employed in the western European fertilizer industry has declined by more than 80%. The United States fertilizer industry also has experienced a large number of mergers and acquisitions since the beginning of the 1980s. In India, five companies account for 48% of the ammonia capacity and 54% of the urea capacity. Several of the major fertilizer producers are state-owned or farmers' co-operatives – the fertilizer industry is not one of large multinational corporations.

Basically the manufacturing processes are simple. To produce nitrogen fertilizers the industry fixes atmospheric nitrogen. Phosphate rock is treated with acids to make it more soluble and hence more readily available to plants. Potash needs little chemical processing. However, the large scale of the plants has required considerable technical innovation, and the scale enables the most advanced technology to be incorporated. In modern plants the use of energy is highly efficient. Most atmospheric emissions have been reduced to acceptable levels. Other losses to the environment are minimal. The emission of carbon dioxide in ammonia production is unavoidable, but can be minimised by optimising energy-use efficiency. As in other spheres of human activity, this is the price to be paid for the benefits of large-scale food production which are currently considered to outweigh the cost.

The elimination of certain naturally occurring harmful elements in phosphate rock is a problem that remains to be resolved due to the economics. Fertilizers are very bulky, low value materials which cannot support expensive processing.

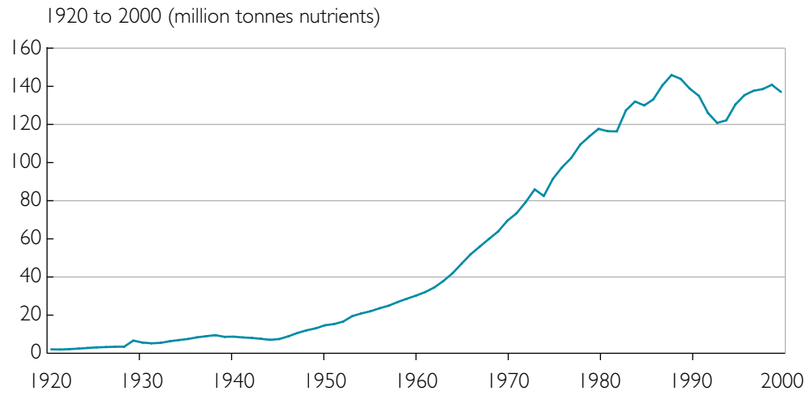
The natural resources required for the production of fertilizers are sufficient for centuries to come. They are unlikely to be a constraint to fertilizer production even in the very long term, but, of course, waste should be avoided and recycling optimised.

The report argues, therefore, that the main constraint to sustainability is at the use level, on the farm. The problem is that nutrients, especially nitrogen and phosphate, which escape into the environment can lead to the proliferation of plant organisms whose presence in excess is harmful, quite apart from the wasteful economic loss.

At present, nutrient use efficiency is low in most developing countries. In developed countries considerable progress has been made but more can be done. Influencing the use of mineral fertilizers is difficult in view of the very large number of farmers are involved. Furthermore, the manufacturer is often separated from the end user by a distribution system that has to handle millions of tonnes of material. In India, for example, there are 260,000 fertilizer retailers in direct contact with the farmer.

2.1 Introduction

Figure 1: World fertilizer consumption



Source IFA

Mineral fertilizer use has increased dramatically in recent decades to meet the food needs of a fast-growing population. About 2.2 billion people now depend directly or indirectly on fertilizer for their daily food. As a result, in many developing countries, fertilizer supply is as politically sensitive as food supply itself [Park, 2001]. Fertilizer use is uneven: in some places it is overused, in others too little is applied, and in still others they are optimally used. These differences occur within and across countries and even seemingly 'optimal' total applications may hide imbalances between individual nutrients.

Discussions about mineral fertilizers and sustainable development must be based on a clear awareness of the differences between developed and developing countries. Developed countries are mature markets, where food security is assured and overproduction not unheard of. Major soil fertility problems have been solved and environmental concerns have become as important politically as food supply, if not more so. Developing countries continue to face food insecurity and serious problems of soil degradation exacerbated by nutrient mining.

Agricultural conditions are also very different. Most developed countries lie in temperate zones where soils retain organic matter for long periods, and many developing countries are in the tropics where soil organic matter breaks down as much as four times faster.

2.1.1 A review of the challenges

This report attempts to review the relationship between the mineral fertilizer industry and sustainable development, outlining the contributions that mineral fertilizers can make and the challenges that must be met if the industry's future is to be sustainable. It presents industry initiatives and responses, and outlines major areas for future improvement. Although every attempt has been made to

give an accurate overview, space constraints limit the depth of discussions and the exhaustiveness of case studies. Nor does the report purport to have solutions for all the challenges listed.

The issues are crosscutting and overlap into many areas. Readers may be surprised by the amount of space dedicated to agriculture. This is because the fertilizer industry recognises that the major environmental impacts of its products occur in the field, and accepts its role in minimising unwanted effects beyond the factory gate.

We also included positive impacts that the industry has had with regard to the various sustainable development issues brought into focus by the United Nations conference on environment and development. This is because we believe that a discussion of the sustainability of the industry should take the good with the bad, especially as decisions about what is most sustainable may involve trade-offs between different objectives. Obviously these contributions do not in any way cancel out the efforts that need to be made in other areas.

The task for this report was to look at progress since 1992, but many efforts from the fertilizer industry began well before this date, in an early recognition of the importance of overcoming major sustainability challenges. The reader is encouraged to see this document as a starting point for discussion and co-operation among a wide range of relevant players.

2.1.2 The fertilizer industry

The world mineral fertilizer industry is extremely heterogeneous. Among the largest producers, one finds giants of the chemical industry in all parts of the world – companies with sales measured in billions of dollars. Producers of the main raw materials for fertilizer production form an important part of the petrochemical and mining industries. At the other extreme, there are many small enterprises which have no primary chemical production at all, they buy all their materials to make mixtures or blends, which are often termed 'compound' fertilizers.

Because of this complexity, not all initiatives undertaken by the fertilizer industry are covered in this report. Notably, readers are referred to chemical industry and mining reports to learn more about initiatives such as Responsible Care and the Global Mining Initiative (and its 'Mining, Minerals and Sustainable Development' project) in which many members of the fertilizer industry participate. Fertilizer companies also participate in sustainable development initiatives of organisations like the International Chamber of Commerce (ICC) and the World Business Council for Sustainable Development (WBCSD).

In the 1970s and 1980s, the geographical balance of the industry shifted strongly toward the former communist economies and the developing countries. The communist countries pinned their faith on fertilizers to spearhead the modernisation of their agriculture and improve poor crop yields. The developing countries viewed fertilizers as a strategic necessity to combat the threat of famine in a situation of rapid population growth. Those with abundant natural gas, phosphate rock or potash saw fertilizer production as a primary means of economic development. Finance from lending agencies such as the World Bank was often available on favourable terms.

All this led to a rapid growth of production capacity and a sharp increase in state ownership. In the 20 years from 1965 to 1984 the share of state enterprise in the world ammonia industry rose from 30% to 64%. In the potash industry, it rose from 40% to 65%, and in the phosphoric acid industry, from 10% to 46%. Similarly, by the mid-1980s, nearly 60% of world phosphate rock production was state-owned.

Figure 2: Nitrogen fertilizer production

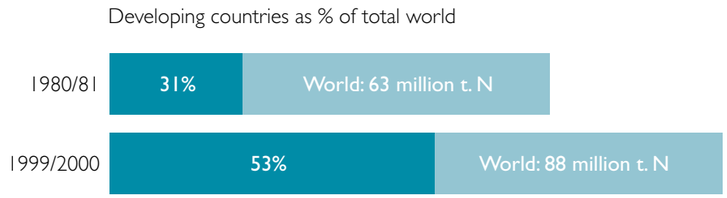


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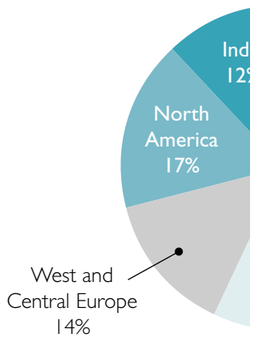
Figure 3: Nitrogen fer



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