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The principal mission of the World Phosphate Institute (IMPHOS) is to promote greater phosphorus use as principal component of fertilizers as well as key element in industrial applications. Phosphate rock minerals are the only significant resource of phosphorus. They are nonrenewable and their availability is a growing concern in the long and medium term. While phosphate fertilizer demand will grow steadily over the coming decades, due to rising population and growing demand for better diets, high-grade economically recoverable phosphate mineral reserves are gradually depleted.

This is a major issue for policymakers and phosphate industry leaders, who have been for a long time advocating responsible use of phosphates to meet the increasing demand for phosphate products. With the anticipated requirements for phosphate for agricultural and industrial uses, the world is likely to run out, in the near future, of low-cost recoverable phosphate rock.

The World Phosphate Institute, whose member companies account for almost 70% of known phosphate reserves, has a key role to play in developing and extensively promoting technologies for efficient production and use of phosphates. The sustainability of world agriculture depends considerably on the ability of the world phosphate industry to reliably supply quality-phosphate products at costs that are affordable by farmers and profitable to phosphate producers.

Playing a key role oftentimes down to farmers' level, IMPHOS covers almost every region of the world, ranging from East Asia to West Asia, East to Central and West Europe, and North to sub-Saharan Africa. The many activities that IMPHOS has conducted on improving the effectiveness of fertilizer phosphorus use and environment-friendly production of phosphate products served in the development and large-scale dissemination of best management practices and best available technologies.

Among the best management practices promoted by IMPHOS, the balanced use of fertilizers in the sense of combined use of N and P fertilizers in proper ratios, clearly demonstrated, particularly in Asia, the many benefits to farmers and countries, which include the increase in crop yields and financial incomes, and the protection of the environment.

The protection of ground and surface waters and croplands is a big issue in industrial nations where intensive cropping prevails and agriculture still plays an important social and economic role. IMPHOS work in Europe demonstrated that phosphates do not pose risks to the environment where balanced and responsible use of fertilizers is common practice.

Equally true in the developing world where high population growth and large food deficits prevail, and efforts are being made to further the use of fertilizers, the adoption of balanced fertilization would result in a significant breakthrough and turn around their present situation of low crop productivity.

Countries in West Asia and North Africa (WANA) are facing a more complex situation: Severe water shortages often compromise crop production. For effective use of water and phosphate fertilizer, fertigation is considered one of the most efficient method of applying both fertilizer nutrients and water, as demonstrated by IMPHOS work in several parts of WANA.

Yet, the efforts of IMPHOS could not bear fruit without its longtime involvement in international cooperation with fertilizer industry associations (IFA, IPNI, and IPI), Florida Institute of Phosphate Research (FIPR), the Food and Agriculture Organization of the United Nations (FAO), the International Atomic Energy Agency (IAEA)...etc. This cooperation helped IMPHOS to fulfill its role as spokesperson for the phosphate industry and enabled it to take part in the analysis and design of international policies that affect phosphates and their products.

New challenges appear. Nonrenewable fossil energy resources are becoming too depleted to meet the increasing demand, and global warming is threatening the world ecology and sustainable economic development. In this context, biofuels are getting more attention. The global market for biofuel is on the threshold of fundamental change, creating new opportunities for fertilizer use to produce more efficient energy crops.

Not only new demand exists, but also enhanced phosphate use in agriculture continues to be critical in view of the fact that one billion people today still live with limited access to food and, in the decades to come, about 80 million people will be added every year to the world's population. Undeniably, sound management of non-renewable resources is very challenging. I am confident that the World Phosphate Institute is strongly committed to this task and is willing to partner with agricultural agencies, fertilizer industry organizations and research institutions that share common interest and goals.

MOSTAFA TERRAB
The World Phosphate Institute has pledged continuous effort to expand balanced use of fertilizers for sustainable growth of crop yield to meet the increasing world’s demand for food. Over the past decades IMPHOS designed and carried out many worldwide activities that contributed significantly to enhancing crop production in several regions of the world, particularly in Asia and Europe, where the focus was on balanced and efficient use of fertilizers.

These activities included the implementation of surveys, desk studies, laboratory and field experiments, as well as convention of workshops, seminars, and conferences, and display of large sets of data and information in project reports, booklets, and leaflets as well as audio and video recordings.

Many of these activities have been published in the Institute’s previous annual reports and other relevant documents. In this report, recent achievements from Pakistan, India and Hungary are presented in demonstration of IMPHOS effort to expand phosphate use and promote profitable and environment-friendly crop management practices.

**SUSTAINABLE GROWTH AND BALANCED USE OF FERTILIZERS FOR PRODUCTIVE AGRICULTURE**

**BALANCED FERTILIZATION PROMOTION AT FARM LEVEL IN PAKISTAN**

**Impact on Crop Production**

For the past two decades, the National Fertilizer Development Centre (NFDC) in Pakistan implemented an agronomic project in Pakistan in collaboration with provincial soil fertility and plant nutrition organizations and with the financial and technical support of the World Phosphate Institute (IMPHOS) and the Food and Agriculture Organization of the United Nations (FAO).

This Project was implemented in three phases:

**Phase 1** from 1987 to 1990, involved the conduct of three types of experiments:
- Demonstration trials at farm level to show the impact of balanced fertilization on crop yields.
- Response curves to phosphate application and calibration with available soil P
- Effects of cumulative applications of phosphate fertilizer and their residual effects on crop yields and soil P status

**Phase 2** lasted for four years, from 1996 to 2000, and involved three types of trials:
- Demonstration trials at farm level
- A special promotional campaign involving similar demonstration trials but limited number of treatments (two or three)
- Effect of balanced fertilization on crop yield and soil fertility on permanent sites


The objectives set for the Project were to demonstrate the quantitative increase in yields and economic return that can result from balanced fertilizer use, and create awareness among extension workers and farming community about the need for adequate use of phosphate.

In the project period, demonstrations were laid out on farmer’s fields on wheat, cotton, rice, maize, sugarcane and onion crops. Trials were conducted on permanent sites in a wheat-rice cropping system to observe the
impact of balanced fertilizer use on maintenance / build-up of soil fertility status and the yield of wheat and rice.

Under the motto “Seeing is Believing”, farmer’s field days were organized at the demonstration sites in all provinces, e.g., Punjab, Sindh, Balochistan, and North Western Frontier Province to show to farmers the impact of balanced fertilizer use. Two symposia, organized to this effect in 1997 and 1999, attracted high-level participants including many planners, researchers, extension agents, and experts from the fertilizer industry.

The Project has generated considerable and valuable results over the years, with 720 demonstration trials and 515 tests. In addition, the results were broadcast, e.g., through farmer’s field days, national symposia and the documents and information made available to extension services, including brochures, and guidebooks translated into regional languages. The impact on farmers was judged considerable.

The results show that balanced fertilization increases crop yield and farming profitability. The findings have been publicised through leaflets, workshops, TV and radio broadcasts, and general media.

During the period of about 10 years, a number of developments took place in government policy, fertilizer use and crop productivity. In addition, it is believed that this Project has had definitely an input in the following areas:

**Phosphate Consumption**

The phosphate consumption doubled from 419,000 tonnes P$_2$O$_5$ in 1996-97 to 865,000 tonnes in 2004-05. The growth in phosphate consumption was 9.5% per annum, compared to 4.4% annual growth of nitrogen consumption, increasing from 1,985,000 to 2,796,000 tonnes during same timeframe (Figure 1). The overall N: P ratio also decreased from 4.8:1 in 1996-97, to 3.2:1 in 2004-05. The per hectare phosphate use increased from 18 kg in 1996-97 to 38 kg in 2004-05 (Table 1).

In product terms, DAP consumption doubled from 699,000 tonnes in 1996-97 to 1,377,000 tonnes in 2004-05, a growth rate of 8.8% per annum. The new product, MAP, was introduced late in the country, but its consumption rose up to 108,000 tonnes. The revamping of Single Superphosphate (SSP) plants increased their production. The use of Triple Superphosphate is also on the increase. In short, during the span of the project, growth in phosphate consumption has been significant.

**Crop productivity**

About 85 per cent of total fertilizer consumption tonnage is applied on five major crops (wheat, cotton, rice, maize, and sugarcane). The productivity of these three major crops, i.e. wheat, cotton and maize showed impressive growth of 3.2 per cent, 5.7 per cent and 8.1 per cent, respectively. The growth in rice and sugarcane, both of which are highly water-demanding crops, was impacted by drought in recent years. The overall productivity of all crops has shown improvement and response to fertilizer use (Table 2).
Research and Extension Activities

Agricultural research and extension organizations were sensitised about the need for balanced fertilizer use, particularly with reference to phosphate. A number of meetings were organized at both national and provincial level to discuss the program and its economic and financial implication for the farming communities, because of phosphate use. Research programs were also developed in close cooperation with institutes.

Field demonstrations were the main instrument of the ‘Seeing is Believing’ program, geared to promote balanced use at the farm level. Farmer’s field days were organized, literature printed in local language distributed, and discussions were held with the farming community. It all created general awareness.

Dialogue with Policy Makers

The National Fertilizer Development Center, having its unique position in the Planning Commission, and being recognized as a neutral organization, enjoys the confidence of policy makers in the Ministries of Finance; Food, Agriculture and Livestock; Planning Commission; and of Industries and Production. The interaction of the NFDC staff with policy makers resulted in a number of policy decisions particularly related to lowering the tax on phosphate fertilizer and a realization of the need to promote its use.

The Government is further considering providing relief to farmers on the phosphate so that its consumption, which is hardly 40 per cent of the recommendations, is adjusted to achieve the potential crop yields.

The Government policy enabled fertilizer companies, such as Fauji Fertilizer Company Limited (FFC), to establish joint ventures with foreign partners to increase phosphate fertilizer production and consumption in the country.

Impact of the Project

The findings of this Project showed that balanced use of N and P increases crop productivity and is profitable for farmers in Pakistan. The total financial gain of about US$ 1,400 million is projected to result from the progressive adoption of balanced fertilization across the country. This would take a number of years and would depend on many other factors working together in order to facilitate the process. However, if the area under balanced fertilization were to rise year after year from the current low level to 50% of the cropped area, then the farming community could gain up to US$ 100 million per year in additional income. It is this income increase that will induce farmers to adopt balanced fertilization and create an accelerating upward spiral of investment in balanced fertilizer use and growth in crop production.

It is worth mentioning here, the Government’s decision to allocate on a provisional basis, the price support of Rs. 50 per bag of phosphate fertilizers from its existing fertilizer subsidy budget, with the effect of September 2006. In mid-2007, the Government intends to review its decision.

Table 2: Crop Production (10^4 tons) and Yield (kg/ha)

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<th></th>
<th>Wheat</th>
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<td>4,305</td>
<td>1,912</td>
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<td>4,333</td>
<td>1,870</td>
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ON-FARM TRIALS FOR INCREASED AND BALANCED USE OF FERTILIZERS IN INDIA

A New Phase of IMPHOS Activities

Pursuant to work on "Strengthening of Research on Phosphorus and Soil Fertility Management in India", a project was conducted in close cooperation with Potash and Phosphate Institute from 1993 to 1998 at agricultural experiment stations in seven States of India. IMPHOS set in operation a number of extension activities from 2000/2001 to 2004/2005. With the collaboration of IFFCO, simple on-farm trials on the "Promotion of balanced and increased use of fertilizer nutrients in low consumption areas" were laid out in nine States: Punjab; Himachal Pradesh; Bihar; Jharkhand; Madhya Pradesh; Chhattisgarh; Uttar Pradesh; Tamil Nadu; and Orissa. The trials were conducted in districts where fertilizer consumption was less than the State average.

IMPHOS is launching another extension project from 2006 to 2009 covering additional States in India, in cooperation with a new partner with whom IMPHOS was able to establish cooperation: Indian Potash Limited (IPL). The justification for this Project is improvement of farmer’s income through increasing crop productivity. Impact analysis is an integral part of this activity.

IPL and IMPHOS are designing and implementing from Rabi (Oct-April) 2006 to Rabi 2009 on-farm demonstrations with the following objectives:

- To contribute to achieving increased crop production in some States of India, through efficient and balanced use of plant nutrients;
- To assist farmers in adopting appropriate plant nutrient management practices through farmer’s field days, workshops, and dissemination of leaflets, brochures and relevant publications.

The simple on-farm trials include N, NP, and NPK treatments. All nutrient applications are based on State recommended doses.

Cropping Systems

The most common cropping system for each of the selected States are followed, including those of the States of Haryana, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Gujarat and Orissa. For the six States, 30 trials will be conducted per State in every season, Rabi or Kharif (May-Sep.). In total, 360 trials will be conducted each year.

The experimental sites are fixed for the duration of the project to monitor changes over time.

Field Days and Workshops

In every State, it is planned to organize a minimum of three field days per season and one workshop. As a result, at least 36 field days and two workshops will be organized every year for the whole period of the Project. These activities are aimed at publicizing IMPHOS research findings in the selected States and disseminating those findings.
FERTILIZER RECOMMENDATION SYSTEMS FOR VARIOUS SOILS AND CROPS OF HUNGARY

Three field trials were conducted in three different main agricultural regions of Hungary: 1) Balatonszentgyörgy, 2) Mezőkövesd, and 3) Sárhatvan.

In 2005/06 the test crop was spring barley, preceded by maize in 2004/2005 and winter wheat in 2003/2004. Fourteen (14) combinations of NPK doses were tested in 3 replicates. Soil samples were taken in August to assess the soil nutrient status, and determine soil nutrient supply categories. All best management practices were applied in order to obtain the potential grain yield level of the region.

1) Balatonszentgyörgy Trial

Prior to the setup of the field trial, on this brown forest slightly acidic sandy loam soil, soil P supply was tested and found to be moderate to good, which is more or less in agreement with the diagnosed plant P supplies.

Maize P supply, as assessed by leaf P concentrations, was very good at the absolute control treatment, and very good to very high at the majority of the treatments. Total P removal by the plant aboveground part (grain + stem) varied between 85 and 151 kg/ha P₂O₅, a removal rate which is more or less in correlation with the amount of P added. The average amount of P taken up was 123 kg/ha P₂O₅, which is double as much as the P uptake by the preceding test crop, i.e., winter wheat. This is by far the highest P uptake of all three IMPHOS maize trials.

Cumulative (1st plus 2nd year) P balance (Table 1) turned out to be negative except in treatments 2, 4, 6, 8, 12 and MEM NAK intensive recommendation.

2) Mezőkövesd trial

Prior to setup of field trials, soil P supply was moderate on this meadow, strongly acidic clay loam. When assessing maize P nutritional status, leaf P concentration was good at the absolute control treatment, and very good at the majority of the treatments.

Total P removed by the aboveground part (grain+ stem) varied between 70 and 131 kg/ha P₂O₅, and was more or less in correlation with the amount of P added, with an average of 96 kg/ha P₂O₅. This is the second highest uptake level among the three IMPHOS trials.

Cumulative P balance in this IMPHOS-2 trial (Table 1) varied, ranging from most negative in the P control plot, to
positive in treatments 2, 4, 6, 8 and the MEM NAK treatment. In treatments with the recommendations of the RISSAC/RIA advisory systems, P balances were slightly negative and in the recommendations of the integrated Talajero, P balance was slightly positive, while in the intensive MEM NAK, it was strongly positive.

3) Sarhatvan trial

The Sarhatvan trial was set up on a calcareous chernozem loam soil, with poor-medium P supply. Soil samples were taken prior to set up of the field trial to estimate initial soil nutrient status, and determine soil nutrient supply capacities. Soil P supply was moderate, which is in good agreement with plant P diagnosis.

When assessing maize nutritional P status, leaf P concentrations were considered as moderate in the absolute control treatment. In all the other treatments, maize P supply varied between good to very good, while extreme in “Treatment 14” (MEM NAK intensive recommendation).

Total P removed by the aboveground part (grain+ stem) varied between 44 and 91 kg/ha P$_2$O$_5$ with an average of 77 kg/ha P$_2$O$_5$, more or less in correlation with the amount of P added. This is the lowest among the three IMPHOS trials. 1-2 year cumulative P balance in the IMPHOS-3 trial (Table 1) varied, being the most negative in the P control and absolute control plots, while most positive in the MEM NAK treatment. In treatments 9 to 13, P balances were slightly negative to slightly positive, which is advantageous both from agronomic and environmental point of view. In the intensive MEM NAK recommendation, P balance was strongly positive ■.

| Table 1: Cumulative P applications and Balances in the 3 sites of the project |
|-----------------------------------------------|-----------------|-----------------|-----------------|
| **Treatments**                          | **Site 1 (Medium to good P supply)** | **Site 2 (Poor to Medium P supply)** | **Site 3 (Poor to Medium P supply)** |
|                                | **Balatonszentgyörgy** | **Mezőkövesd** | **Sarhatvan** |
|                                | P applications (kg P$_2$O$_5$/ha) Year 1+2 | P balance (kg P$_2$O$_5$/ha) Year 1+2 | P applications (kg P$_2$O$_5$/ha) Year 1+2 | P balance (kg P$_2$O$_5$/ha) Year 1+2 | P applications (kg P$_2$O$_5$/ha) Year 1+2 | P balance (kg P$_2$O$_5$/ha) Year 1+2 |
| 1. 0.0.0                          | 0 | -91 | 0 | -146 | 0 | -71 |
| 2. 0.K.P2                        | 200 | 91 | 200 | 40 | 200 | 97 |
| 3. N.K.0                         | 0 | -132 | 0 | -178 | 0 | -95 |
| 4. N.0.P2                        | 200 | 65 | 200 | 13 | 200 | 76 |
| 5. NKP1                          | 100 | -34 | 100 | -84 | 100 | -33 |
| 6. NKP2                          | 200 | 53 | 200 | 17 | 200 | 74 |
| 7. NKP1BU*                       | 150 | -5 | 150 | -46 | 150 | 22 |
| 8. NKP2BU*                       | 300 | 150 | 300 | 85 | 300 | 157 |
| 9. RISSAC-RIA-1                  | 55 | -71 | 123 | -49 | 126 | -4 |
| 10. RISSAC-RIA-2                 | 83 | -51 | 141 | -48 | 143 | 17 |
| 11. RISSAC-RIA-3                 | 111 | -31 | 152 | -24 | 155 | 23 |
| 12. RISSAC-RIA-4                 | 139 | 7 | 164 | -19 | 167 | 31 |
| 13. Talajero Kkt                 | 100 | -57 | 180 | 6 | 120 | 6 |
| 14. MEM NAK                      | 171 | 25 | 311 | 132 | 338 | 203 |

**BU**: one initial build-up P application at the start of the 3-year trial, **RISSAC-RIA-1**: minimum level; **RISSAC-RIA-2**: environmentally friendly level; **RISSAC-RIA-3**: balance based level; **RISSAC-RIA-4**: integrated level; **Talajero Kkt**: integrated recommendation from the laboratory Talajero; **MEM NAK**: intensive recommendation.
MPHOS and the other sponsors of this review (FAO, IFA, IPNI, and TFI) have taken an active interest in its preparation and conclusions because the fertilizer industry, along with FAO, is very interested in phosphorus fertilizer use efficiency and in implementing strategies to improve the efficiency of use of phosphorus.

The major conclusion and practical outcome from this review is that the efficiency with which fertilizer phosphorus is used is often high (up to 90%), when considered over an adequate time scale and evaluated using the balance method.

The driving force for concern regarding the efficiency of fertilizer phosphorus use arises primarily from three sources. Firstly, phosphate rock, from which phosphate fertilizers are manufactured, is a finite, nonrenewable resource and as such, global phosphorus reserves must be used as efficiently as possible to maximize their life span. Secondly, there is the need to maintain and improve the phosphorus status of many soils to grow crops for food, feed, fiber, and bioenergy. This is particularly important in lesser-developed countries where there is still a need to increase food production and improve rural livelihoods. Thirdly, the transfer of soil phosphorus, derived from fertilizers and organic manures (e.g., animal manure and other organic manures and biosolids), from land to surface waters is one of the major causes of the adverse effects of phosphorus-induced eutrophication on the biological balance in such water bodies. Increasing the effectiveness with which soil and fertilizer phosphorus is used will benefit all three of these factors.

The review presents background information on the plant availability of soil and fertilizer phosphorus and focuses on changes in the concepts of the behavior of both soil and fertilizer phosphorus, and partly as a consequence of these changes, the need to both define and assess their recovery and efficiency of use. The methods used are supported by the results obtained from a series of nine case studies taken from farming systems in different agro-ecological zones.

The main outcomes of the review may be summarized as follows:

1. The two most important factors controlling the availability of soil phosphorus to plant roots are the concentration of phosphate ions in the soil solution and the ability of the soil phosphorus reserves to replenish phosphate removed from the soil solution by plant roots, i.e., the phosphorus-buffer capacity of the soil. The latter largely controls the rate at which phosphate ions are released into the soil solution.

2. The understanding of the behavior of phosphorus in soils has changed substantially, particularly during the last 40 years. Very early work (in the nineteenth century) showed that fertilizer phosphorus could be retained (‘fixed’) in soils in forms that are unavailable to plants.

3. Recent work demonstrated that inorganic phosphorus exists in most soils in adsorbed forms, which can become absorbed by diffusive penetration of the phosphorus into soil components. This may result in only a temporary decrease in plant availability. These recent findings of the behavior of phosphorus in soils have largely been responsible for the major reassessment of the recovery of soil and fertilizer phosphorus developed in this review. It is concluded that phosphorus is largely retained by soil components with a continuum of bonding energies, resulting in varying degrees of availability of soil phosphorus to plants. Conceptually soil phosphorus can be considered to be held in four “pools”, the soil solution, a readily plant-available pool, a less readily plant-available pool and a slowly available pool. Experimental evidence shows that there is reversible transfer of phosphorus from these pools. This conclusion is consistent with the often high values (up to 90 per cent) obtained for the recovery of soil and fertilizer phosphorus, implying a high efficiency of use over time.
4. Phosphorus-use efficiency depends on the soil phosphorus status but measurements of phosphorus recovery depend also on crop yield, which can be affected by many factors, including other inputs, particularly fertilizer nitrogen.

5. Several methods can be used to calculate the recovery and efficiency of fertilizer phosphorus, with the method used affecting the result obtained. Of the possible methods, it was preferred to use the 'Balance Method', which expresses total phosphorus uptake by the crop as a percentage of the phosphorus applied, as this method is more appropriate when the residual effects of added phosphorus must be taken into account. Results obtained for the recovery of fertilizer phosphorus obtained with the balance method are always larger than those obtained with the difference method but there are sound reasons for calculating recovery in this way.

6. For phosphorus there is a so-called 'residual effect' whereby the recovery of phosphorus added in fertilizer or organic manures may increase the yield of subsequent crops for many years. For this reason, it is essential to measure this continuing uptake of phosphorus over several years (preferably at least 10) if reliable results are to be obtained for the recovery and efficiency of use of phosphorus.

7. Several case studies have been considered that cover semi-arid, temperate, and tropical agro-ecological zones in eight countries, involving different farming systems. Results from these studies frequently show that phosphorus recovery by the difference method is much larger than the value of 25%, commonly believed to be the upper limit for the recovery of phosphorus applied as fertilizer to field-grown crops. With the balance method, the results often range from 50% to a high value of 90%. The high recovery of phosphorus from previously-applied fertilizer phosphorus over quite long periods of time clearly demonstrates that phosphorus is not irreversibly fixed in unavailable forms in soils. It also implies the reversible transfer of phosphorus between readily- and less-readily plant-available forms, and this is an important process influencing the long-term availability of phosphorus in soils.

8. Several strategies are available for potentially improving the efficiency with which soil and fertilizer phosphorus is used in a farming system where it is low. These include (a) modifying surface soil properties, (b) surface soil management, and (c) management of fertilizer and organic manures. Some of these strategies are site- and cropping-system specific. Individually, they may have only a small impact, but if more than one can be used, the benefit may be larger. However, the extent to which any of these strategies are adopted, or even pursued, will largely be determined by the associated investment cost and the compounded increment benefits that farmers' can obtain considering the rather high P application recovery rates over an extended period.
NON-FERTILIZER PHOSPHATE PRODUCTS

The promotion of scientific research, technical and economic studies relevant to phosphate rocks and processed phosphates is among the objectives of IMPHOS. In this regard, the Institute aims to enlarge the range of present applications and encourage new ones for phosphates. So, during 2006, IMPHOS conducted a study on "Main phosphate derivatives and phosphate products used for purposes other than fertilizers: Present situation and perspectives". This study provided data and information on the immense possibilities resulting from the great variety of P compounds that the chemistry of phosphate has to offer.

The total annual consumption of phosphate-derived-products other than fertilizers represents about 20% of the world production of phosphates including 12 % for detergents, and 5 % for the food industry, whether it be for the preparation of cattle feed, as an additive in human food or yet for food preservation.

The other 3% of the world’s yearly production of phosphates are accounted for by a variety of sectors such as metal processing, the pharmaceutical industry, water processing, flame retardant agents, catalysis, glass or ceramic industry or in various high-technological applications (lasers, fuel cells, nanotechnology…etc.). Even though this section represents only 3% of the global consumption, it nevertheless has the richest variety of applications and by far the most important added value. These phosphate products derive primarily from elementary phosphorus (red and white) and from the phosphoric acid.

White phosphorus is used as a reducing agent in the production of some metal alloys and as rotenticide or insecticides, due to its very high toxicity. It is also used as a major intermediate substance in the preparation of numerous other P products, either as primary derivatives: phosphorus pentoxide (P$_2$O$_5$), phosphorus trichloride (PCl$_3$) and phosphorus pentachloride (PCl$_5$) or as secondary derivatives: ortho-, meta- and pyrophosphoric acids, hypophosphorous acid, phosphine, phosphorus oxychloride, phosphates and polyphosphates.

Red phosphorus is used in less industrial applications than white phosphorus. The red form is used in the production of matches, in pyrotechnics, to prepare flame-retardants, in the industry of semiconductors and to prepare phosphines (PH$_3$), which are frequently used as an insecticide in silos and grain storage plants.

There are four important sectors for the application of phosphates and phosphoric acid:

1. Food applications

The possible applications are based on numerous interesting properties of phosphoric acid and its salts. The acidity is exploited in various applications e.g., in the preparation of soft drinks or baking powder. The buffering power ensures the stability of numerous preparations. The antioxidizing power protects food. The sequestering power controls the flow concentration of calcium, iron and magnesium ions in order to control the rheology of the solutions as well as the evolution of their color through time. The antimicrobial power inhibits microbial growth, a characteristic exploited in the cheese industry.
2. Household Applications

The main applications are in the production of detergents, which offer without any doubt the most significant potential for phosphate use outside fertilizers. Amongst the various detergent products that have been developed, sodium tripolyphosphate (STPP) accounts for about 95% of all phosphate consumption in detergents.

3. Applications in the Health Sector

Phosphoric acid and derivatives are used in the synthesis of various active pharmaceutical substances, to inhibit blood coagulation and to maintain fluidity, in the preparation of tooth paste, and other products of the sector. The non-toxic aspect of phosphates, their capacity to stabilize emulsions, their antioxidant power or the possibility to create pH buffers are all exploited in this sector.

4. Industrial applications

The major applications of phosphoric acid and phosphate products are water and metal treatments, ceramics, enamels and refractory porcelain, paper, paintings, glass, and polymer catalysis.

- For metal treatment, the main application is phosphatation of metallic surfaces with phosphoric acid. This application, pushed forward by the automobile industry, represent about 90% of the consumption of phosphoric acid in this sector of activity.

- In the leather industry, linear polyphosphates interact with amino groups of collagen fibers of the skin that needs to be treated. By blocking these sites, polyphosphates "mask" the polyphenolic extracts present in the tanning liquor and allow them to act on those same amino groups, leading to the reticulation of various skin constituents, and therefore to its tanning.

- In the cement industry, polyphosphates, such as sodium hexametaphosphate (SHMP) are used as viscosity regulators in various cement-manufacturing stages. In the same way, magnesium phosphate is active in the composition of cements, enabling it to resist high temperatures, up to 1400 °C.

- Phosphate glass has remarkable thermal and optical characteristics. This glass is used, for example, to manufacture lenses for the most powerful lasers in the world, used in research on nuclear fusion.

- The use of phosphates for lithium-ion batteries is a new technology. This technology using lithium-ion accumulators, and an iron phosphate as a cathode, has recently been developed. The advantages of this technology are numerous. As phosphates are stable at temperatures of more than 1000°C, runaway through overheating is therefore no longer possible. In addition, the materials used are not only far less expensive than cobalt, but they are also nontoxic.
Fertilizer is key input in agricultural production. It has enabled food production to grow at a pace exceeding population growth. Phosphate as part of the fertilizer nutrient package helped to drive food crop production to the extent that is necessary to meet the global demand. The link between phosphate and food must not go unnoticed; as the world cannot afford a communication breakdown. The fact that interested public must know about the vital contribution of phosphate industry to improved diets of people everywhere and their hopes for a better standard of living underpins IMPHOS communication efforts illustrated below:

**IMPHOS ANNUAL REPORT 2005**

This report informs the reader of several activities and achievements of the Institute in Asia and Central and Eastern Europe. It stated the benefits of balanced and efficient use of phosphate fertilizers for increased crop yields and enhanced crop quality, and above all, the expected financial returns to farmers.

It has also covered the environmental issues associated with phosphate compounds and potentials for new phosphate industrial applications of very high added value. Several workshops, field days and symposia held in many regions of the world were reported along with the main publications.

Finally, recent market trends in phosphate production, supply and demand got good coverage in this report.

**IMPHOS LEAFLET**

In 2006, IMPHOS updated the leaflet that presents its activities. Under the heading of "The World Phosphate Institute Serving the Growth of the Phosphate Industry and Sustainable Cropping Systems", the newly designed leaflet featured the following themes:

- Promoting the Growth of Phosphate use,
- Enhancing the Image and Role of the Phosphate Industry,
- Partnering with International Organizations,
- Strengthening Relationships among Phosphate Producers,
- Interacting with the International Scientific Community,
- Acting as a Source of Information on Phosphates,
- IMPHOS Creation and Membership.

The leaflet can be downloaded from IMPHOS website (www.imphos.org), as can be the IMPHOS Phosphate Newsletter.

These documents are considered powerful communication tools enabling IMPHOS to reach out to the public.
IMPHOS / FAO / NFDC INTERNATIONAL SYMPOSIUM

The symposium on "Balanced Fertilizer Use: Impact on crop production" was held in Islamabad, Pakistan, on 30-31 October, 2006. This symposium was jointly sponsored and organized by IMPHOS, FAO (Food and Agriculture Organization) of the United Nations and the National Fertilizer Development Centre (NFDC) of Pakistan.

The Symposium was opened by Dr. M. Akram, Federal Minister, Deputy Chairman, Planning Commission (the Chairman of this commission is the Head of State of Pakistan). This Commission decides, among other issues, on all matters relating to the use of fertilizer in Pakistan.

In his address, Dr. Akram stressed the importance of agriculture in Pakistan, the many achievements and challenges ahead, in particular, the need for more efficient use of water and natural resources, and increased crop production.

Beside the Inaugural Session and the Concluding Session, the symposium comprised five technical sessions, which were:

1. Fertilizer use: world perspective,
2. Balanced fertilization: crop production and economic benefits,
3. Country contribution (China, India and Indonesia) on the theme of balanced fertilization,
4. Plant nutrient management: emerging challenges,
5. Role of industry and extension.

The second session of the Symposium provided an opportunity to present the main achievements of the IMPHOS/FAO/NFDC Project conducted in Pakistan from 1986/1987 to 2005/2006, stressing the notable increase in crop production and the important financial gain that would result from the application of balanced fertilizer in the whole country or, what is much more realistic, on 50% of all cropped areas. More information on this Project was provided to the participants by making available a printed copy of the final Project report entitled "Balanced fertilization through phosphate promotion at farm level" and a copy of a desk study commissioned by FAO on "The impact of deregulation on the fertilizer sector and crop productivity in Pakistan".

One important session of the symposium was Session 5 on the "Role of Industry and Extension". The main fertilizer producing companies, Fauji Fertilizer Company Ltd, Engro Chemical Pakistan Ltd, and Pak Arab Fertilizer (Pvt) Ltd were invited to present the challenges, needs and opportunities for the promotion of balanced fertilization in Pakistan. The main outcomes from this Session are outlined below:

- The need to support P application through subsidies, as this is presently the case for N, but not for P and K fertilizer use
- The allocation of more resources to ensure wider dissemination (through a mass communication programme) of results obtained in the area of fertilization practices
- The critical importance of establishing close relationships between fertilizer producing companies and agricultural research institutes
- The potential of other fertilizer products, such as compound fertilizers, for promoting balanced and efficient use of plant nutrients.

The Federal Minister for Food, Agriculture and Livestock, Mr. S. H. K. Bosan, chaired the Concluding Session entitled "Fertilizer use efficiency and crop productivity: Where we stand and what should be done?"; a session which provided a forum for suggestions, recommendations, and conclusions. At this session, the Symposium stressed the following:

- There is need to establish a "Task Force" on the issue of balanced and efficient fertilizer use that will provide recommendations to the government of Pakistan and monitor the different issues relating to fertilizer use in the country. This Task Force should comprise all stakeholders, including the fertilizer industry.
- Clear guidance from the government is needed in fertilizer use, pricing policies and subsidies.
The growing need to address the issue of low soil organic matter (which needs to be maintained or increased), and micronutrients, such as Zn and B, that are impacting some crops in some cropping systems.

The interest of using the approach of Crop Production Regions (CPRs) to develop more efficient crop management.

The Symposium was attended by more than 140 people from research institutes, agricultural universities, extension institutions, and fertilizer producing companies. Participants from OCP, CPG, FAO, FAI, APPI (the Fertilizer Institute of Indonesia), IFA, Kali and Saltz, and from neighboring countries, namely, China, India, Indonesia and Singapore contributed much to broader discussions and the sharing of different views on the theme of the Symposium.

Representatives from the fertilizer industry, federal and provincial agriculture departments, and local media, also attended this event.

Proceedings of this Symposium will be issued in 2007.

**ADDING VALUE TO PHOSPHATES**

The Second International Conference on Valuing Phosphates (COVAPHOS II) was organized in Marrakech (Morocco) in November, 2006 by the Researchers’ Network on Phosphates (RECHERPHOS). This Network is interested in fostering research and development of multiple uses of phosphates, by promoting exchange, enhancing knowledge and strengthening cooperation on this broad topic.

IMPHOS contributed a presentation on cadmium removal from phosphates and offered help with the translation of the technical language. The latter assistance was instrumental in offering during the course of the Conference, simultaneous interpretation in English and French.

The Conference was attended by 281 participants ranging from research students to academic researchers and industry workers. Fifty papers were given and 73 posters were displayed, in addition to four round tables led by nine speakers. The proceedings will be available before the next COVAPHOS III Conference scheduled for November 2008. All information can be obtained from RECHERPHOS Secretariat at the Website: www.recherphos.com.

**FIELD DAYS TO EXTEND TO FARMERS PROJECT ACHIEVEMENTS IN INDIA**

As part of IMPHOS efforts to enhance phosphate fertilizer use in India, field days are organised periodically in different Indian States covered by our activities.

The farmer’s field days and various meetings were held at the demonstration sites in the Punjab State in 2006.
They were an opportunity to demonstrate to farmers the crop response to efficient and balanced fertilization.

Over 100 farmers attended those events, where different specialists presented packages of practices for growing good crop and maximising profits.

FIELD DAYS TO EXTEND PROJECT ACHIEVEMENTS TO FARMERS IN HUNGARY

Three open field days were organized in three regions of Hungary in June 2006. About 50 people took part, slightly more than in 2004/2005.

People came from the universities and research institutes, as well as from the Soil and Plant Analysis Laboratory Network and other soil analysis laboratories, and from far distances of even 200 to 250 km. They were very interested in knowing the new, environment-friendly and cost-saving fertilizer recommendation system, and to check how it works under field conditions. There was progress compared to 2004/2005: The experts from the Chamber for Agriculture came in much higher number than last year. From Autumn 2005 until today, the Chambers for Agriculture in 17 out of 19 counties have adopted the new, cost-saving and environment-friendly fertilizer recommendation system, and started to use it in the new, EU-financed agro-environmental program. It is very encouraging to see, in the context of this program, 1.3 million hectares were sampled for soil test purposes in 2005.

On each sites, Mr. Tamas Arendas from RIA reviewed the effect of NPK fertilization on wheat baking and corn fodder quality. Mr. Peter CSATHO from RISSAC introduced the scientific basis of the new, environment-friendly fertilizer recommendation system, as well as the treatments underpinning the field trials. Their explanations generated the interest of people in the new fertilizer recommendation system, elaborated by RISSAC and RIA.

The paper on the results of the 2005 IMPHOS field trials with maize was published in "Agronaplo", one of the farmers' monthly magazines. Other papers published in other magazines, gave a summary on the 2004 and 2005 agronomic and economic results of the treatments, concerning the different fertilizer recommendation systems in Hungary.
IMPHOS/FAI AWARD

The Fertilizer Association of India and IMPHOS chose the theme of their award as the "Role of Phosphorus in Improving the Yield and Quality of Crops". The award was launched in 2001 to publicize and encourage research on phosphorus that might help farmers. The winner of the 2006 Award was Dr J.C. Tarafdar from Central Arid Zone Research Institute in Jodhpur.

IMPHOS INPUT TO THE FAO/FERTILIZER ORGANIZATIONS WORKING GROUP MEETING

The FAO publishes every year statistical data on world and regional mineral fertilizer supply and demand. The data are prepared and discussed by the Fertilizer Association Working Group under the FAO coordination. Considering the world growing population, the limited area of arable land and water scarcity, food security cannot be achieved without use of mineral fertilizer. Thus, it is of paramount importance to know the prospect for the mineral nutrient supply and demand for the foreseeable future.

As in previous years, the meeting held in October 2006 was an opportunity to discuss among members of the Group the global fertilizer demand and supply forecasts. This meeting reviewed the forecasts for the period 2006-2011. IMPHOS input was solicited because of its expertise in phosphate fertilizer.

To introduce the subject, a study on the "Fertilizer Requirement for the period 2015-2030" conducted on behalf of FAO led to the main conclusions that the annual rate of growth of NPK fertilizer demand in the long-term, i.e. over a quarter of a century will be as follows:

**Annual growth of NPK demand**

- Developing countries: 2.2%
- Developed countries: 0.2%
- The World: 1.2%

As far as phosphates are concerned, world consumption stood at 37 millions t. P₂O₅ in 2005/2006, and was projected to increase at the annual rate of 2.8% for the next five years.

**IMPHOS INPUT**

1. Presentation of a paper under the title: "Current World P₂O₅ Trends and Outlook". This is an update of a previous paper on "Phosphate Industry: Growth and Challenges" presented by IMPHOS at the International Conference of British Sulphur held in Brussels in April 2006.

2. The approach to phosphate supply/demand balances presented by IMPHOS, is based on its perception of the current state of phosphate market, namely:
   - Phosphate fertilizer consumption has been consistently increasing and the current world phosphate supply/demand balance is showing little surplus.
   - This balance will likely persist for sometime until the new phosphoric acid plants under construction start producing in around 2010 and beyond.
   - Phosphate rock availability at reasonable recovery cost seem to be limited.

**GENERAL CONCLUSIONS ACCORDING TO IMPHOS**

- Phosphate rock is a valuable resource that may get in short supply in the future: The message was clearly
stated in the recent issue n° 413, July/August 2006, of the "Fertilizer International" Journal and was restated in this meeting.

- While the USA and China are the largest world producers of phosphate mineral, they should direct one half of their mining operations to low grade mineral that is difficult to mine, process and beneficiate at keenly competitive costs, if they continue to mine at current production levels.

- China phosphoric acid projects under construction will add over the period 2005-2010 some 2.5 million tonnes P₂O₅ of additional phosphoric acid capacity. This tonnage will require about 9 million tonnes of phosphate rock as feedstock, which will be locally consumed to the detriment of any export outside China.

- According to experts, the world biofuel production is projected to grow by more than 10% per year over the next decade. Biofuels could give a new impetus to phosphate fertilizer consumption as a result of cropping millions of hectares in Europe to oilseed crops that can be processed into biodiesel.
PHOSPHATE ROCK

According to a recent U.S. Geological Survey report, economically recoverable phosphate reserves are estimated at only 12.5 billion tonnes. About 75% of this active reserve is located in Morocco (Table 1). Yet, this estimate remains elusive because it depends on variable economic conditions and new technological developments.

There are three types of ore reserves:

- Sedimentary rock reserves constitute 90% of global reserves and supply 85% of current rock production.
- Igneous rock constitutes 9% of world reserves, concentrated mainly in South Africa and Russia.
- Metallic phosphate ore has become a minor source of phosphorus.
- Guano reserves have largely been mined out (e.g., Nauru Island) and their share dropped to 1%.

Furthermore, average $P_2O_5$ content of phosphate rocks is drastically declining as high-grade rock becomes a scarce resource. New sophisticated beneficiation processes are required for sustainable, cost-effective production of merchant-grade products. This situation will lead in the near term to readjustments in production.

Table 1: World phosphate rock reserves (% share)

<table>
<thead>
<tr>
<th>Country</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morocco</td>
<td>75.0</td>
</tr>
<tr>
<td>China</td>
<td>7.7</td>
</tr>
<tr>
<td>USA</td>
<td>6.3</td>
</tr>
<tr>
<td>South Africa</td>
<td>4.0</td>
</tr>
<tr>
<td>Jordan</td>
<td>1.7</td>
</tr>
<tr>
<td>Russia</td>
<td>1.5</td>
</tr>
<tr>
<td>Egypt</td>
<td>1.1</td>
</tr>
<tr>
<td>Tunisia</td>
<td>0.8</td>
</tr>
<tr>
<td>Oceania/Australia</td>
<td>0.6</td>
</tr>
<tr>
<td>Syria</td>
<td>0.5</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**PHOSPHATE TRENDS AND OUTLOOK**

Production and Use

Phosphate rock production in 2006 reached 168 Mt. The figure in this report is based on a more realistic estimate of Chinese rock production at 56 Mt, which is much higher than the figure in the preceding report based on the official Chinese production statistics (Figures 1&2 based on IFA data, 2006). The lack of growth in the world production in 2006 came mainly from a steep reduction in North America by an overall 5Mt, as a result of reduced processed phosphate capacity (-14% in home deliveries) and lower domestic sales.
Over 30 countries are currently producing phosphate rock for use in domestic markets and/or international trade. However, the world’s top nine producing countries in Eastern Europe and Central Asia, North America, North and West Africa, and West Asia, in addition to China, accounted for nearly 90% of world’s total estimated production in 2006. The USA, China, and Morocco are the three leaders in phosphate rock mining and together account for 67% of production. It remains true that a large number of producers are in developing countries and the phosphate industry makes an important contribution to their economies (Figure 3).

The primary use of phosphate rock continues to be the production of phosphoric acid (PA). About 70% of PR mined annually is converted into wet process phosphoric acid (WPPA) in a first step. Almost all wet process phosphoric acid is then converted into upgraded phosphate materials.

The second primary use is in the manufacture of downstream phosphate fertilizer products directly from phosphate rock. About 23% of PR mined annually or 12 million m. t. P₂O₅ is used for this purpose.

Elemental phosphorus (P⁴) production accounts for 6% of total production and animal feed ingredient (AFI) for 1% of PR production. Elemental phosphorus is used to manufacture thermal phosphoric acid, a component of food additives and a number of industrial products, some of which compete with products obtained via the wet process phosphoric acid route (Figure 4).

**PHOSPHORIC ACID**

**Production:**

Phosphoric acid is obtained mainly by reaction between phosphate rock and sulfuric acid. In 2006, global phosphoric acid production registered a 2% increase over 2005, to 34.5 Mt P₂O₅. Most of the growth occurred in China in 2006 (Figure 5).

Over the past two decades there has been a distinct trend towards the chemical processing of phosphate rock in countries where it is mined. The concentration of
phosphoric acid production capacities in just a few rock-producing countries (USA, China, Morocco, Russia, Tunisia, Jordan, Senegal and others) is a trend which is bound to continue because integrated phosphate mining and processing offers significant technical and economic advantages.

PHOSPHATE FERTILIZERS

During the past 30 years a large proportion of the increase in phosphate fertilizer production has been in the form of phosphoric acid based fertilizers, mainly ammonium phosphates (Diammonium and Monoammonium Phosphates). Global production of these processed phosphates grew by 5% in 2006, to 24.1 Mt P2O5 (IFA, 2006). China accounted for the bulk of growth (Figure 6).

Morocco remains the world's largest rock exporter with a 46 per cent-share of global exports. In 2006, Moroccan rock exports estimated at 13.5 Mt rose by 1% over 2005, followed by Jordan. While deliveries from other main exporters declined in 2006, notably from China, Russia (Figure 7).

PHOSPHATE TRADE

**Phosphate Rock**

Initially, the main form of traded phosphorus was phosphate rock, but this trade has declined sharply over the last 20 years as vertically integrated industries have been developed at or close to the site of the mines. World phosphate rock exports fell from 53 million tonnes product in 1979 to 27 Mt in 1993. Another net decline of 4.5 Mt in global rock trade was registered between 1998 and 2003. The year 2004 saw a reversal of this trend with a significant 6 percent increase over 2003. Global trade in 2006 was soft, with lower imports than the previous year into West Europe, the USA and Oceania.

**Processed Phosphates**

The global trade of MAP and DAP in 2006 decreased by an overall 3% to 8.2 Mt P2O5, that of phosphoric acid by 2% to 4.9 Mt P2O5. The main features of the processed phosphates trade during 2006 were the continued decline of DAP sales into China and a significant 30% increase of DAP exports to India (Figure 8).
GLOBAL PHOSPHATE SUPPLY/DEMAND SITUATION AND OUTLOOK

Phosphoric acid
The global phosphoric acid capacity in 2006 was relatively stable at 43.3Mt.

In 2006, the global supply of phosphoric acid is estimated at 30.7 Mt and the global demand of phosphoric acid estimated at 29.4 Mt P₂O₅. The global supply/demand balance of phosphoric acid shows a marginal surplus of 1.3 Mt P₂O₅ in 2006 (2.1 Mt in 2005).

Thus the supply/demand situation was fairly balanced in 2006 (Figure 9).

Phosphate Fertilizers
The world’s phosphate fertilizer capacity barely expanded in 2006. In fact, very little net capacity was added in 2006. Global DAP and MAP capacity grew by 0.3% Mt and 0.5 Mt, respectively, while TSP remained flat. The global processed phosphates capacity is estimated at 32.3 Mt P₂O₅ in 2006. Phosphate fertilizer demand remained firm in China, India, South-East Asia and Turkey.

AGRICULTURAL SITUATION
As far as agriculture is concerned, cereals play a central part in the human diet. Today, half of the world’s cropland is devoted to cereals. Wheat, rice and coarse grains are the major users of fertilizer and together account for over 50% of all global NPK fertilizer use. Market conditions improved during the second half of 2006. World cereal production in 2006 remains close to two billion metric tonnes, according to FAO. At the same time, global cereal demand was booming, essentially under the influence of a recovery of world meat production and surging ethanol production in USA. Consequently, international cereal prices were high, especially those of maize. This context is translating into a larger global area planted to cereals in 2007.

<table>
<thead>
<tr>
<th>Year</th>
<th>Wheat</th>
<th>Coarse grain</th>
<th>Rice (milled)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>632.0</td>
<td>1,053.2</td>
<td>406.9</td>
<td>2,092.1</td>
</tr>
<tr>
<td>2005</td>
<td>624.5</td>
<td>1,002.3</td>
<td>421.9</td>
<td>2,048.7</td>
</tr>
<tr>
<td>2006e</td>
<td>598.1</td>
<td>993.5</td>
<td>421.9</td>
<td>2,013.5</td>
</tr>
</tbody>
</table>

Wheat production was down in 2006 but there are favorable early prospects for 2007. The latest estimate for world production of coarse grains in 2006 stands at 993.5 million tonnes, down from 2005 but above the average of the past five years (Table 2). Rice production stagnated in 2006, as several regions are hit by adverse weather conditions. This context is expected to lead to a larger global area planted to cereals in 2007 with corresponding expansion in fertilizer demand. 

![Figure 9: World phosphoric acid supply/demand](image-url)
BOARD OF DIRECTORS

On 7 June 2006, the Board of IMPHOS held its annual meeting in Cape Town, Republic of South Africa, coinciding with the IFA Annual Conference. Mr. Mostafa Terrab, incoming President of IMPHOS as of February 2006, chaired the meeting. At his suggestion, the Members of the Board expressed their sincere thanks to former president, Mr. Mourad Cherif, for his leadership and efforts to develop and strengthen IMPHOS. Then, the Board reviewed the agronomic and technical work accomplished during 2006, and considered the activities planned for the following year along with the budget.

While stressing the interest of the significant IMPHOS cooperation with the many international and national organizations in several regions of the world, the Board underlined how it would be more beneficial to IMPHOS to further involve the research systems in the countries of IMPHOS Member Companies, in the conduct of the activities of the Institute.

While stressing the interest of the significant IMPHOS cooperation with the many international and national organizations in several regions of the world, the Board believed that these efforts do not yet adequately cover the important and diverse activities conducted by IMPHOS in different regions. It therefore directed the Secretariat of the Institute to intensify efforts in the area of communication. The Board made preliminary suggestions and indicated some avenues relating to the way the Institute should operate, with the aim of bringing more efficiency and consistency into the functioning of IMPHOS.

Finally, the Board adopted the work plan for 2006, whose main features are the preparation and organization of an international symposium on balanced fertilization, and an extensive review of the production and marketing of phosphate products other than fertilizers.

THE AGRONOMIC AND TECHNICAL COMMITTEE

The Committee held its first meeting of 2006 in April. At this meeting, the Committee was briefed largely on the communication and awareness-enhancing activities developed by IMPHOS on the issue of cadmium in phosphate fertilizers. This work was undertaken with the assistance of a communication agency based in Europe. It much helped in channelling and facilitating the flow of relevant data and information to stakeholders.

The committee also discussed the draft program of the international symposium on balanced fertilization, planned for October 2006 in Islamabad, Pakistan. It made constructive suggestions on the result that the symposium should strive to accomplish. Finally, the committee held a joint session with the Scientific Committee of IMPHOS to share views on the document prepared by this latter Committee under the title: "Setting major priority areas for the research activities of IMPHOS".

In November, the Agronomic and Technical Committee held its second meeting of 2006. It was an opportunity to largely discuss the outcome of the symposium held in Pakistan, and to reflect in particular on the historical decision taken by the Government of Pakistan to financially support the use of phosphate and potassium fertilizers with the objective to promote more balanced fertilization in Pakistan. The Committee recommended to build on this experience and to consider undertaking similar moves in other countries where the Institute is carrying out lasting efforts to further balanced use of plant nutrients.

ACTIVITIES OF THE EXECUTIVE ARMS AND ADVISORY BODIES OF IMPHOS
THE SCIENTIFIC ADVISORY COMMITTEE

In its meeting held in April 2006, the IMPHOS Scientific Advisory Committee (ISAC), in a joint session with ATC extensively discussed the feedback from the ATC on the document it drafted on setting major priority areas for the research activities of IMPHOS. This discussion helped to further refine the preliminary proposals made by ISAC relating to:

1. Food security through higher crop yields and better food quality;
2. Food safety and environmental quality;
3. Effect of heavy metals in phosphates;
4. Micronutrient application in relation to phosphate fertilization;
5. Energy management in phosphate fertilizer production, and
6. Phosphorus-nitrogen interactions and the environment.

These topics will be developed with the objective of deriving future possible activities to be conducted.

On the draft of the final report from IMPHOS project in Pakistan, the Committee inputs helped to finalize the overall project report before its publication in October 2006.

The Scientific Committee held its second meeting in December 2006 and shared on this occasion its views on "Phosphoric acid production and processing", the topic of a presentation made by a member of the Committee.

The Committee reported on the situation of the review on fertilizer and soil phosphorus efficiency, a study being conducted jointly by three professors including two members of ISAC, and sponsored by IMPHOS and other international organizations (FAO, TFI, IFA, and IPNI).

The ISAC discussed the results from the Project conducted in Hungary on the comparison of several fertilizer nutrient applications on wheat, maize, and barley. This research outlined the need for continuously establishing P balances to assess, over the course of the wheat-maize-barley rotation, the soundness and "sustainability" of the fertilizer treatments that are being tested.

Further, the Committee commented on the planned desk study on major phosphate derivative products other than fertilizers, whose main objective is to provide sound information on their current uses as finished products or intermediates in the manufacturing of various compounds.

Joint meeting of the Scientific and Agronomic and Technical Committees of IMPHOS
IMPHOS is a non-profit making Institute founded in 1973 by the world’s principal producers of phosphate rock. Its primary mandate is to collect and disseminate scientific data to support phosphate fertilizer management. This in turn will help increase crop yield and sustain crop production in such a way that the demand for food by the world’s population is met in a sustainable and environmentally acceptable way.

Among its objectives, IMPHOS seeks to promote increased and efficient phosphate use in both developed and developing countries, consistent with the principles of integrated plant nutrient management. The Institute also seeks to help improve farming practices conducive to larger crop yields and environmentally sustainable crop production.

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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AFA</td>
<td>Arab Fertilizer Association</td>
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<tr>
<td>ATC</td>
<td>Agronomic and Technical Committee</td>
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<tr>
<td>BAT</td>
<td>Best Available Technologies</td>
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<tr>
<td>BF</td>
<td>Balanced Fertilization</td>
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<tr>
<td>BMP</td>
<td>Best Management Practices</td>
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<tr>
<td>Cd</td>
<td>Cadmium</td>
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<tr>
<td>CE</td>
<td>Central Europe</td>
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<tr>
<td>CPA</td>
<td>Crop Production Area</td>
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<td>CSTEE</td>
<td>Comité Scientifique sur la Toxicité, l’Ecotoxicité et l’Environnement</td>
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<tr>
<td>DAP</td>
<td>Diamonium Phosphate</td>
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<tr>
<td>EECA</td>
<td>Eastern Europe and Central Asia</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>FAI</td>
<td>Fertilizer Association of India</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<td>FIPR</td>
<td>Florida Institute of Phosphate Research</td>
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<td>IAEA</td>
<td>International Atomic Energy Agency</td>
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<td>IFA</td>
<td>International Fertilizer Industry Association</td>
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<td>IFFCO</td>
<td>Indian Farmers Fertiliser Cooperatives</td>
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<td>IMPHOS</td>
<td>Institut Mondial du Phosphate</td>
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<td>IPII</td>
<td>International Potash Institute</td>
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<td>IPL</td>
<td>Indian Potash Limited</td>
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<td>IPNI</td>
<td>International Plant Nutrient Institute</td>
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<td>ISAC</td>
<td>IMPHOS Scientific Advisory Committee</td>
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<td>JAIPC</td>
<td>Japanese Association of Inorganic Phosphorus Chemistry</td>
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<td>MAP</td>
<td>Monoammonium Phosphate</td>
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<tr>
<td>MEM NAK</td>
<td>Intensive System</td>
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<tr>
<td>Mt</td>
<td>Million tonnes</td>
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<tr>
<td>NFDC</td>
<td>National Fertilizer Development Centre</td>
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<tr>
<td>PDF</td>
<td>Portable Document Format</td>
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<tr>
<td>PR</td>
<td>Phosphate Rock</td>
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<tr>
<td>RBF</td>
<td>Recommended Balanced Fertilization</td>
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<td>RIA</td>
<td>Agricultural research Institute of the Hungarian Academy of Sciences</td>
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<td>RISSAC</td>
<td>Research Institute for Soil Science and Agricultural Chemistry</td>
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<td>Rs</td>
<td>Roupies</td>
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<td>SCOPE</td>
<td>Scientific Committee on Problems of the Environment</td>
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<td>Talajerò</td>
<td>Integrated Fertilization</td>
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<td>TFI</td>
<td>The Fertilizer Institute</td>
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<td>TSP</td>
<td>Triple Superphosphate</td>
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<tr>
<td>USA</td>
<td>United States of America</td>
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<td>USSR</td>
<td>Union of Soviet Socialist Republics</td>
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<td>WANA</td>
<td>West Asia and North Africa</td>
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