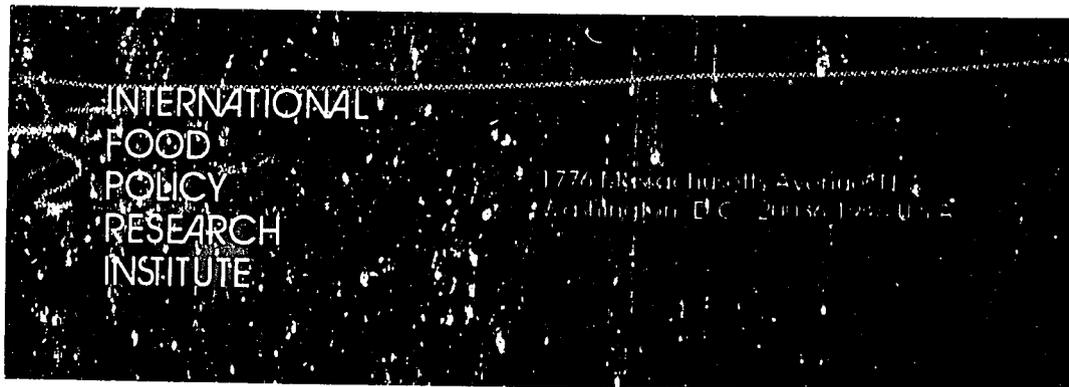


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Fertilizer's Greener Pastures

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Fertilizer's Greener Pastures

Chemical fertilizers are more plentiful, but obstacles still stand between the product and the farmer

Bruce Stone

Since the 1950s, when it almost exclusively used natural fertilizers, China has increased supplies of manufactured fertilizer faster than almost any other country in the world, by expanding both imports and production capacity. Now the world's largest user of manufactured fertilizers, China is again planning a decade of rapid growth. In 1987 alone, which saw a shift toward higher-quality products, China's fertilizer consumption rose 3.4 percent, and production increased 22 percent. In 1988, production grew by another 3.1 percent.

During the 1950s and early 1960s, the national and key provincial governments distributed the growing supply of fertilizer under their control with a certain degree of efficiency. During this period, the State limited the number of eligible users and allocated the chronically scarce supplies of fertilizer to farming areas with high yield potential. During the late 1960s and 1970s, small, county-owned plants provided the largest increments to aggregate supplies. This brought fertilizer use to a wider spectrum of localities and farmers, but growth was still concentrated in market-oriented areas with high-yield potential. However, during the late 1970s and 1980s, fertilizer availability began to grow so quickly that continued annual allocation of large quantities of fertilizers (especially nitrogen fertilizers) to the same areas became problematic, yet China was not able to direct the fertilizer to new areas. The resulting market crisis in 1985 left dozens of county governments with rapidly deteriorating inventories of volatile ammonium bicarbonate (ABC) products.

With the farm goods and fertilizer market in disarray, the government

declared an import moratorium and scrapped plans for several new production facilities. However, central planners reconsidered their fertilizer policy when poor grain harvests followed this retrenchment. This situation was exacerbated by a rural credit crisis (see *The CBR*, January-February 1985, p. 43). The Agricultural Bank of China, created to facilitate government purchase of farm products, depends on rural credit cooperatives for the bulk of its deposits. The financial needs of the grain and cotton purchase stations—which disproportionately rewarded surplus deliveries—broke the Agricultural Bank after bumper harvests in 1983 and 1984. But with the Agricultural Bank closed, local credit cooperatives could not extend loans to farmers for fertilizer purchases, and farmers in many cases had trouble withdrawing their savings to buy fertilizer.

Just as sustained rapid growth in foodgrain and cotton production overloaded and rendered obsolete China's scarcity-oriented farm goods purchase system, a decade of very rapid growth in production and imports of fertilizer overloaded the fertilizer purchase, allocation, and distribution systems. In both cases, administrative headaches caused by sustained successful production precipitated the sudden introduction of

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reform measures, including contract systems, which replaced unlimited commitments by the State to purchase.

Comprehensive improvements

China's Seventh Five-Year Plan (FYP, 1986-90) shows a vigorous recommitment to rapid development of domestic fertilizer production capacity and implies continued willingness to allocate large quantities of foreign exchange for fertilizer imports. Ambitious production targets also characterize plans for the upcoming Eighth FYP (1991-95), although financing arrangements for large-scale capacity expansion and appropriate policies to ensure adequate input supply to the small-plant sector are not yet well established.

In addition to commitments aimed at increasing supplies of fertilizer, China has undertaken a series of initiatives to promote wider availability and greater returns to fertilizer use. These measures include increased fertilizer distribution by plan to medium- and low-yield areas; various efforts to achieve greater allocational efficiency through limited operation of markets; extensive soil testing and diversification of fertilizer production to counter soil deficiencies and fulfill crop needs for balanced nutrients in various regions; new encouragement of small-plant production; and better control of fertilizer quality.

Ambitious expansion goals

Following a major commitment of financial resources to import 13 large synthetic ammonia/urea complexes in the early 1970s (eight of them from America's M.W. Kellogg Co. or its European joint venture), investment in new capacity was allowed to decline, leading to a fall in

additions to capacity during this decade. But the perceived benefits of increased fertilizer application during the 1965-81 period and the inability to control farmer allocation of surplus grain for feed ultimately encouraged planners to commit more resources to fertilizer production in the Seventh FYP (see chart 1). Expected additions to capacity include 11 new medium- and large-scale diammonium phosphate (DAP) plants, two plants to produce compound fertilizers (NPK), and one large potassium chloride complex. Complete production lines for perhaps eight of these facilities will be in operation by 1990-91. By November 1987, a nitrophosphate plant and three other facilities for producing DAP or NPK had been added to the list of upcoming projects.

In 1988, a single superphosphate plant with 400,000 metric tonnes per year (tpy) capacity was completed in Gansu; large synthetic ammonia/urea complexes were opened in Ningxia and Xinjiang; and a 300,000 tpy synthetic ammonia plant was opened in Shanxi. The status of the remaining facilities for the 900,000 tpy nitrophosphate plant in Shanxi and a 120,000 tpy ammonia phosphate plant in Shaanxi, both scheduled for 1988 completion, is unconfirmed. A phosphate plant scheduled for completion in Anhui last year is expected to start up in 1989, along with new ammonia phosphate production capacity in Liaoning and Nanjing. In addition, at least five medium-scale plants are being converted for production of urea and DAP, as are 30 smaller ABC and single superphosphate plants, with an additional 70 being planned. The Qaidam Basin facility in Qinghai is expected to produce 140,000 tonnes of potassium chloride and 80,000 tonnes of magnesium chloride this year.

With capacity expansion proceeding with some speed at the medium- and large-scale facilities, attaining the production goal of 100 million tonnes within a year or two of the original 1990 target date is not out of the question, particularly if adequate raw materials and energy can be guaranteed to the small-plant sector. The production goal for 1995 was raised last summer from 120 million standard tons of product to 130 million tons, with 150 million tons, or approximately 32 million tons of nutrients, targeted for the year 2000.

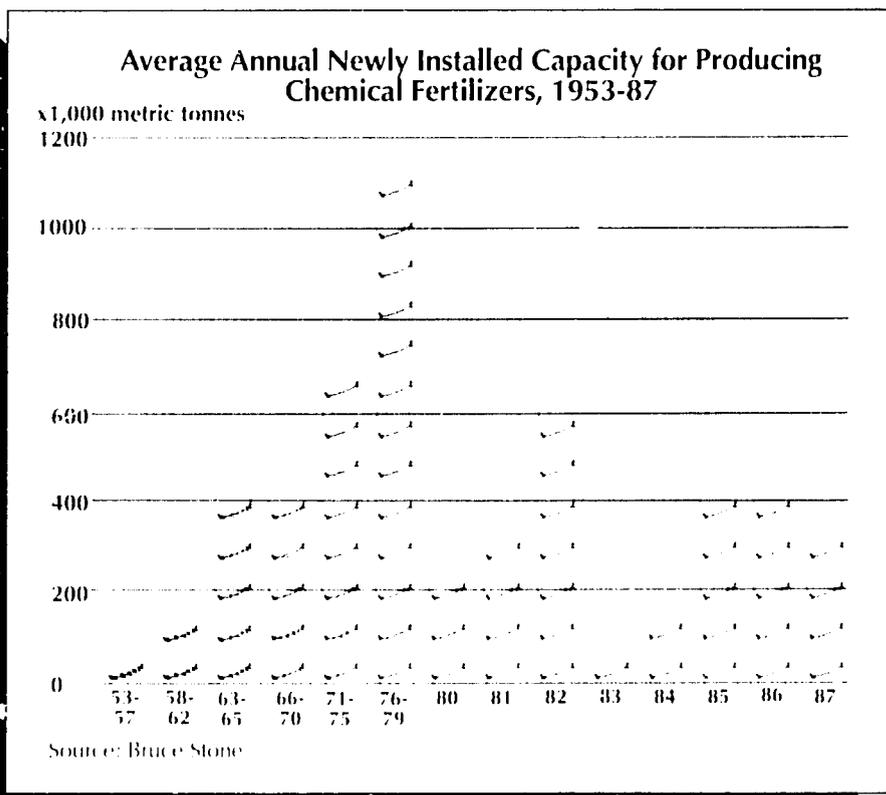
Detailed plans for the Eighth FYP, however, seem to be changing almost monthly. In 1988, they included completion of 10 large DAP projects. But financing still poses a major obstacle; the year-2000 target would require an annual rate of construction investment 4.5 times the current level, if achieved primarily via large-scale plants. Recent cutbacks in capital construction plans coupled with credit restrictions to address inflation, will further impede domestically financed capacity. International organizations are helping a little, and some foreign governments, particularly Japan's, are providing assistance. But despite recent reforms, Japanese assistance has typically been organized around Japanese industrial ability to provide nitrogen production facilities, whereas higher proportions of phosphates and potash will be required in China's future. In any case, continued high levels of production and even capacity expansion in the small plant sector are probably indispensable if China is to reach the year-2000 targets.

Surpassing expectations

With a boom in capacity utilization within the small-plant sector and a portion of the capacity expansion planned in the Seventh FYP coming onstream, domestic fertilizer production reached record levels for

each of the major nutrient groups in the late 1980s. In 1987, total production surpassed the State plan by 14 percent, leading to a substantial upward revision in the 1988 target. Nitrogen production in 1987 totaled 13.423 million metric tonnes, 16 percent over 1986 and 11 percent higher than the record 1984 total. Phosphate production was up 39 percent over 1986, to 3.259 million tonnes, surpassing the 1983 record by 22 percent. And potash production, though still small relative to requirements, grew 60 percent, to 40,000 tonnes, surpassing the 1984 peak by 29 percent.

According to preliminary compilations, nitrogen fertilizer production grew 1-3 percent in 1988 and phosphate by 17-23 percent. The industry as a whole recovered from raw material and energy shortages during the summer to exceed even 1987 production (by 3-7 percent) as well as its initial production target, but may have remained almost 2 percent short of the ambitious 1988 revised target of 85 million standard tons. Furthermore, production problems in the small nitrogen plant sector in the late spring of 1988 spread to the small phosphate sector by early 1989. While there was some recovery in the nitrogen sector by early spring this year, complete resolution is no doubt being delayed by the political crisis following the pro-democracy move-



ment in May-June.

Preliminary production figures for the first six months of 1989 showed a respectable increase (to 42.98 million tonnes or 9.05 million tonnes of nutrients), but the large gap remaining to reach the 1990 target is evidence of both incomplete resolution of small-plant problems and delays in large-plant completion.

Surge in imports

The reacceleration in production in the late 1980s was not accompanied by a cutback in imports (see chart 2). As was the case during most of the 1977-84 period, fertilizer imports grew rapidly along with domestic production capacity. In 1987, China's fertilizer imports (10.9 million metric tonnes of product, or around 4.7-4.9 million tonnes of nutrients) rose 18 percent over peak year 1984 and 114 percent over the 1986 level, which had been artificially restrained by an import contract moratorium commencing in the second half of 1985. Preliminary compilation of 1988 imports suggested an 18 percent increase over the record 1987 level in nutrient terms, but the final figures released by China's Customs Bureau actually show 14.7 million tonnes of product weight imports, for a 35 percent increase. These figures imply imports of around 6.6 million tonnes of nutrients and a considerable increase in last-quarter deliveries. Yet even with this replenishment of inventories, 1989 imports may not be reaching adequate levels to compensate for production and

distribution problems, compounded by the government's distraction by other issues, including the possibility of major policy revisions. But China's leaders will inevitably realize that increasing fertilizer imports to support good harvests will assist any government's effort to secure or maintain legitimacy.

Promoting grain gains

Increased applications of fertilizer in the late 1980s restored harvests that had suffered from the 1985-86 import restraints and from confusion in the farm goods, fertilizer, and credit markets. Following a 1986 increase in fertilizer supplies, foodgrain production in 1987 recovered 3.4 percent to 404.73 million tonnes, within 0.64 percent of record year 1984, despite a decrease in foodgrain sown area of 1.43 percent. Paddy production recovered to within 2.2 percent of peak year 1984, when sown area was 3.1 percent greater. Corn and soybean production reached new output records, and sweet and white potato output grew 11.4 percent over 1986, reflecting a movement of both land and fertilizer resources toward the country's most land-efficient major feed and industrial crops. Complementing substantial developments in water control and extended use of high-yielding crop varieties from 1950-80, increased fertilizer supplies—not prices, incentives, or the responsibility system—were primarily responsible for the remarkable performance in foodgrain production during the

last decade, from 285 million tonnes (1975-77) to an average of 400 million tonnes (1987-88) (see chart 3).

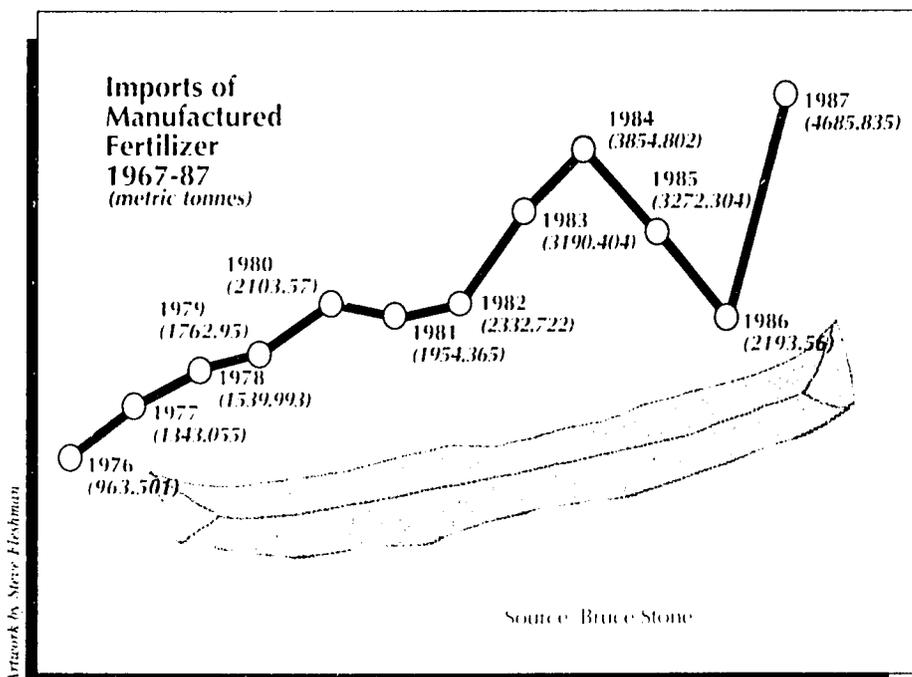
Increased fertilizer application also partially compensated for the negative effect of unusually severe natural disasters on national foodgrain output in 1988. Although droughts in central China and floods throughout the northeast kept foodgrain production from reaching 1984's record of 407 million tonnes, timely and plentiful fertilizer supplies provided bumper harvests elsewhere, allowing the national grain harvest to reach 393.79 million tonnes in 1988, surpassing the target of 390 million tonnes. At the same time, growth in fertilizer use has been instrumental in generating rapid and continuous growth in crop value for non-grains during the last decade.

Conversely, inadequate production of fertilizers by the small-plant sector, insufficiently offset by imports, could, if left uncorrected, begin to have noticeable aggregate impact on output beginning with the 1989-90 over-wintering crop.

Redirecting supplies

During the early decades of severe fertilizer supply shortage, throughout even high-potential farming areas, country and provincial governments restricted access to high-quality fertilizers to farmers who sold large quantities of agricultural goods to the State. China's system of distribution ensured that dynamic farming areas would receive increasing supplies of fertilizer to continue growth of farm yields, secured high average returns to fertilizer application, and guaranteed the State's ability to purchase large shares of the increments to food production from growing fertilizer use.

With rapidly increasing fertilizer supplies, however, the advantageous system of concentrating incremental supplies of fertilizer in the same market-oriented areas became a liability, as more and more fertilizer was directed to localities with farm yields already approaching their potential or at least experiencing rapidly declining marginal returns to nitrogen use. Lower-yield areas, on the other hand, that might have benefited substantially from more nitrogen fertilizer, were unable to obtain supplies. Skewed distribution



Artwork by Steve Hochman

of specific fertilizers has also exacerbated soil nutrient imbalances.

China is now working to correct these imbalances by making more fertilizers—especially nitrogen—available to low- and medium-yield areas and providing more phosphates, potash, and micronutrient fertilizers to areas already receiving plentiful supplies of nitrogen products. Both efforts are essential.

Balancing nutrients

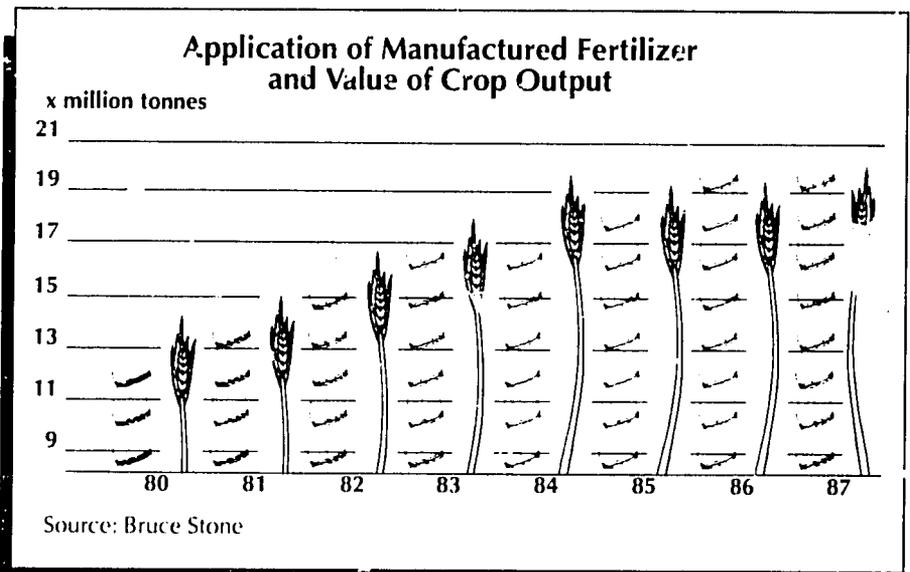
Soil nutrient deficiencies, which have held back yields in many farming regions, are only partly due to uneven distribution of fertilizer. The application of fertilizer overall has not been sufficient to prevent nutrient depletion, and capacity investment and import policies have historically stressed nitrogen fertilizers, neglecting phosphates and especially potash (*see* chart 4). As a result, growing deficiencies threaten to hinder future harvests and are already raising the per-unit costs of continued yield growth in high-application areas.

According to national tests done in 1981-83, almost all Chinese soils are deficient in nitrogen, and soils throughout 73.4 percent of the country's cultivated farmlands lack phosphate, including 54.2 percent with serious deficiencies. Potash deficiencies are found on 23-47 percent of the farmlands, depending on how the deficiency is defined. According to a study by the Soil and Fertilizer Institute in Beijing, fertilizer application targets for the year 2000, even if fulfilled, would not eliminate net annual losses in major soil nutrients.

The Chinese Academy of Agricultural Sciences estimates that China's appropriate application ratio of nitrogen to phosphate to potash—the NPK ratio—is 1:0.5:0.2. Some Chinese scientists suggest a preferable ratio of nitrogen to phosphate would be as high as 1:0.7, while others argue that 1:0.4 will be adequate during the 1990s. Applied nutrient ratios in none of China's provinces fall within this range; only Heilongjiang and a few other low-application provinces where use of *all* nutrients is deficient are approaching the preferred ratios.

Aware of the problem, China has established a national soil test network and surveyed soils in almost all counties. The basic information from such tests is being made available to

Artwork by Steve Fleishman



local planners and, increasingly, to farmers. China has also begun to shift emphasis toward phosphate and potash fertilizers. By preliminary estimates potash imports rose by two-thirds in 1988 to a new record of 1.35 million tonnes, some 25 percent greater than the 1984 record. About 200,000 tpy of domestic potash production capacity should be completed by 1990. Both mining and production capacity for phosphates is undergoing rapid, though unsteady, development (*see* box).

Encouraging small plants

China's recent decision to resume limited encouragement of small-scale fertilizer producers partially reverses a decade-long campaign aimed at controlling the growth of this subsector and weeding out the least efficient plants. Some planners at the national level would prefer to do without China's 1,800 small plants, which have nevertheless provided a useful supplement to large- and medium-scale facilities and have protected many local economies from the vagaries of policy regarding foreign exchange allocation for imports and State and provincial allocation of fertilizers.

Despite periodic central government opposition during the last decade, local governments have continued to develop small-plant capacity. Small plants accounted for around 10-11 million tonnes of nutrients in 1987, including roughly 7-8 million tonnes of nitrogen and 3 million tonnes of phosphates. The small-plant nitrogen sector reportedly has the capacity to produce

more than 8.2 million tonnes of nutrients.

Pressure from local governments and recognition that a healthy small-plant sector would inevitably continue to be key to achieving agricultural targets finally resulted in a change in both strategy and tactics toward small plants. China now not only permits the sector's development but also provides a portion of the investment and technical assistance necessary for a number of facilities that currently produce volatile, low-quality ABC to convert to DAP, MAP, or urea production. The Seventh FYP provided ¥1 billion to local plants to partially support capacity expansion and conversion from ABC to urea, despite efficiency potentials substantially below those for larger-scale facilities. The largest portion of investment required for such conversion or expansion, however, must be raised locally.

Marketing reforms

Marketing reforms predated the attitude adjustment toward small plants. The immediate catalyst was the inability of the State's bureaucratized distribution system to handle continuous growth in supply, particularly during a crisis in rural finance. In 1985 small- and medium-scale ABC plants were forced to organize marketing for up to 50 percent of their output. Until that time, such plants sold virtually all their output to the local branch of the Agricultural Inputs Corp. (AIC). The AIC distributed it, along with fertilizer purchased from outside the county, to local marketing and supply

cooperative outlets and, to a minor extent, to AIC branch offices in other counties, all ostensibly according to annual allocation plans drawn up by the local planning commission in consultation with agricultural departments.

As part of the deal, provincial and local governments were supposed to hold down official intra-county factory fertilizer prices but could negotiate prices elsewhere. However, provincial and national governments would guarantee only a portion of required inputs at preferential prices. Plants would have to arrange purchase for the remainder themselves, at prices to be negotiated with suppliers.

In addition, the government legalized fertilizer trade among farmers. This move allowed farmers, legal distributors, and farm produce purchasers to recapture a greater share of former—and substantial—black-market profits. China also attempted to resolve some of the most severe geographic imbalances in fertilizer use within regions by permitting plants to sell their surplus anywhere

within the country at negotiable prices.

Bureaucratic recentralization

To better control the fertilizer trade, China in the mid 1980s recentralized imports through the China National Chemicals Import and Export Corp. (SINOCHEM). In October 1987, the government attempted to recentralize the domestic fertilizer trade through the AIC, an organization better equipped than factories and farmers in warehousing, transport, and communications facilities to market and distribute fertilizers. But the intrinsic responsiveness of AIC outlets to local government and the structure of incentives related to their operation suggest that this recentralization of trade is as handicapped in improving allocative efficiency as the previous arrangement.

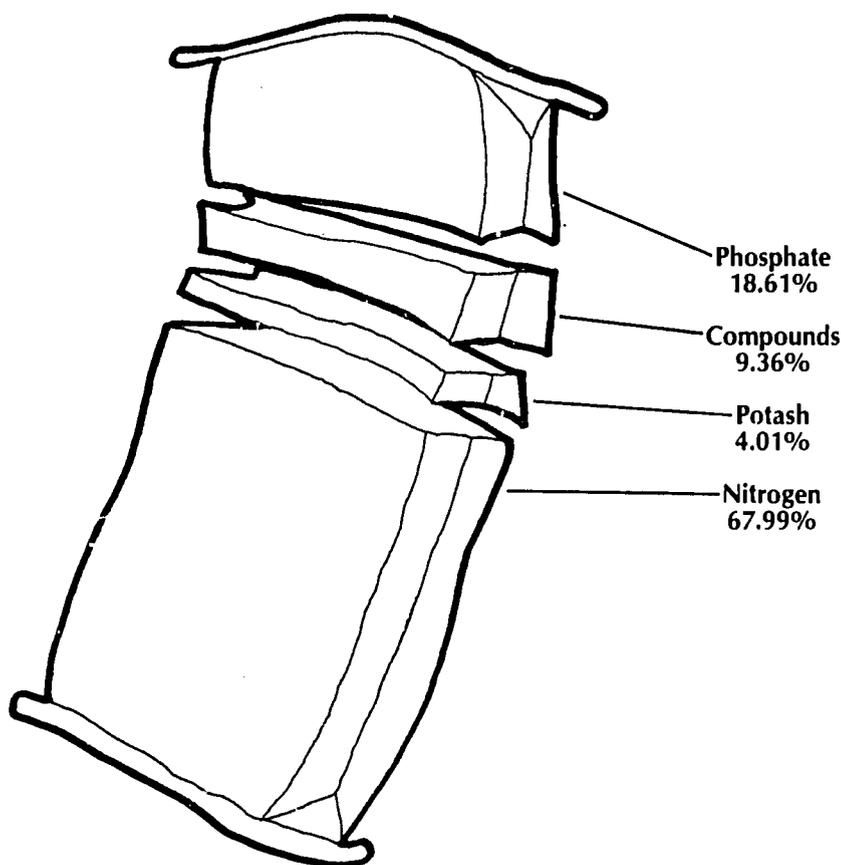
The recentralization of fertilizer imports was ostensibly undertaken to prevent unscrupulous traders and criminals posing as traders from taking advantage of unsophisticated local governments and farmers and

to prevent irresponsible local authorities from contracting for excessive imports. But the recentralization has not eliminated imports through non-SINOCHEM channels, only reduced their flow and made such flows illegal. And by reducing competition from legal suppliers, especially those operating most directly from foreign sources, leverage to extract exorbitant prices is increased in the hands of corrupt officials, resource-hungry local governments, and the smaller and less responsible corps of illegal traders. The answer to this problem is wider, not narrower, local access to alternative suppliers.

There is no question that both imports and domestic production had increased at rapid rates since the late 1970s. But there is no evidence that the rate of increase in early 1985 was excessive relative to previous years and no evidence of building stocks of imported products. There were, however, accumulating inventories of ABC at some AIC locations, which prompted local outlets to reduce further purchases of ABC from local plants. Small plants, however, with only a few production days of warehouse capacity, were even less equipped to handle inventory build-ups, and many ceased operation. The national government, fearful of permanent deterioration in the idle nitrogen plants, eventually ordered them to resume production.

The attempted and partially successful recentralization of imports, the 1985-86 import contract moratorium, and the market reform allowing local plants to sell their output directly once local AIC quotas were fulfilled all arose out of this situation. While local plants had a hard time initiating their fertilizer marketing activities on short notice, when the reform was introduced in 1985, they seemed to have little trouble in 1986 after several months of preparation, and even in 1987, when imports recovered to record levels. There were cases of substantially higher prices charged to farmers, but on the whole, price increments required for fertilizer to reach demand surplus localities were modest, and exceptionally high prices were no higher than previous black market rates. If anything, the exploitation of farmers with extremely high prices or by shorting their contracts seems to have accelerated along with attempted recentralization.

China's Nutrient Application Proportions, 1986



Artwork by Steve Fishman

So why is recentralization of domestic distribution deemed necessary? There seem to be several reasons. First, when fertilizer plants sell directly to townships in other counties, as well as to county AIC offices themselves, they are generally taking over existing markets from higher-cost local producers. This naturally irritates plant managers and county governments accustomed to controlling local supply, although distribution alternatives usually exist: exporting to markets served by even less efficient producers and developing the distribution system and marketing arrangements in more remote areas of the county where fertilizers are scarce. National and provincial planners cannot have it both ways. If markets are to be expanded to remote areas, there probably must be considerable supply pressure. If markets are to raise production and allocative efficiency, unwelcome pressure on high-cost suppliers is inevitable. In any case, greater quantities of fertilizer provided by competitive suppliers is the only final answer to exploitation of farmers through exorbitant fertilizer prices.

But a more fundamental State concern is that freer access to fertilizer means less leverage over farmers, considered necessary for a variety of reasons. Farmer compliance with local and national government policy has been an important constraint on administrators for at least 15 years. Control of access to fertilizers is one of the only—and often the most important—means to secure compliance. Of course, it also allows large additional charges on deliveries to be assessed with impunity, for either private or public gain. While the national and provincial governments emphatically oppose illegal accumulation, they inevitably depend on the cooperation of the local elites.

There is the illusion that with fertilizer distribution recentralized through the AIC, responsibility will be established, and illegal price escalation or diversion of fertilizers can be identified and eliminated. But this has not proven to be the case. As efforts to recentralize have intensified in 1987-89, problems in fertilizer distribution have increased, not abated. The crux of the difficulty is that county branches of the AIC are more responsive to county governments than to the provincial and national AIC leadership. And county

governments operate with increasing independence, especially during periods of national and provincial budget retrenchment.

Finally, the national government has typically preferred limiting foreign exchange expenditures on agricultural goods and inputs. Recentralizing distribution underwrites the attempted recentralization of imports, which, it is hoped, will help the State gain greater control over foreign exchange expenditures for fertilizer.

Plant closures

By the second half of 1988, China's inflation rate had accelerated to around 30 percent, which, coupled with aggregate shortages of coal, natural gas and electricity, led to rapidly escalating prices for these inputs to small nitrogen plants. But with recentralization of distribution through AIC channels, the opportunity for small plants to cover additional expenses with higher incremental charges for fertilizers was considerably inhibited. Consequently, the number of plants operating in the red increased from 122 in 1987 to 272 by September 1988. Many plants operated well below capacity due to lack of capital to finance the higher prices, or else to sheer inability to secure the inputs or freight transport permits. In many cases, even the government-guaranteed input levels were not supplied. By January 1989, almost 400 medium- and small-scale plants had ceased operation. Several interrelated factors contributed to plant closings: the inability to procure adequate coal, electricity, natural gas, sulfuric acid, and freight transport, and the economic bind of inconsistent price and allocation policies.

A number of small factories have seen the handwriting on the wall—in the world of frequent policy change and partial regulation, fertilizer ex-factory prices will be under greater regulatory pressure than input and transport prices. Their response, when possible, has been to diversify horizontally into manufacture of other products whose output prices are apt to be under less downward pressure from governments. This of course exacerbates production shortfalls in fertilizer facilities, with more profitable production lines compet-

ing within the same company for similar scarce inputs.

The situation worsened after the 1988 autumn harvests, and the Ministry of Chemical Industry took up the matter in urgent terms with the State Planning Commission, which responded with emergency directives to provinces to provide priority guarantees of coal and electricity to small plants, prevent further closures, and reopen idle plants to avert permanent deterioration. Local response, while less than ideal, seems to have been significant. In Jiangsu, 29 of the province's 43 closed plants had reopened by January. In Henan, 20 of 30 had reopened by early March. But 22 of Shaanxi's 30 plants were still closed in February, and 30 of the 89 small-scale plants in Shandong had not reopened by mid-spring.

Obstacles to increased use

Despite considerable efforts to make fertilizer more available, China must still overcome several impediments to increased applications of fertilizer. The State must more effectively control or certify quality. Reported cases of fraud and sale of defective or ersatz fertilizers increased along with the legalization of additional suppliers.

The effectiveness of chemical fertilizers in high application areas are possibly being reduced, as dwindling amounts of organic fertilizers are used. Many farmers in suburban areas are applying less manure to their land, because the value of their labor in off-farm and non-foodcrop farming activities is much higher than it was a decade ago—so much so that even the increase in crop prices cannot justify the large labor expenditures required for organic manure application.

The traditional Chinese practice of hand-weeding has also fallen off, reducing returns to fertilizer use (since fertilizers stimulate weeds, which compete with crops for soil and fertilizer nutrients). More herbicides are being used, but China's chief alternative to hand-weeding has been the application of plastic sheeting around seedlings. Unfortunately, plastic sheeting has also been in short supply, and the overall availability of herbicides is still very low.

On the distribution side, the results continue to be less than ideal. Circulars were issued recentralizing distribution through AIC channels in

October 1987, again in fall of 1988, and again in January 1989, suggesting a lack of administrative success in accomplishing the policy objective. It is clear the fertilizer plants have, to a significant extent, complied with the policy. But various departments of many local governments have taken advantage of the previous few years of non-unified prices to pile on additional charges and divert fertilizer to more favored or profitable locations themselves. With supplies restricted, profits are centered in local government departments, where, as the sole legal buyers and sellers of fertilizers, surplus value is concentrated, rather than with farmers, fertilizer plants, or competitive traders. Although many farmers pay high prices and contract guarantees are not always honored, fertilizer plants have not prospered, and abnormal scarcities have been artificially generated.

Currently, the most important policy changes would include less import centralization and competitive access to local markets and fertilizer plant production for all quantities beyond contracted requirements of each county government. But with the policy orientation of the currently emerging government, the most that may be hoped for is a crackdown on local governmental and corrupt official abuses. A second important policy objective is inflation control, which would reduce the asset demand for fertilizers and the instability induced by hoarding.

Changing patterns of use

Nevertheless, the obstacles to increasing fertilizer use are not insurmountable, and China's growth rate in aggregate demand for fertilizers shows no fundamental signs of flagging, despite temporary and location-specific problems of adjustment. In fact, the need for fertilizers will increase even more rapidly, as a number of economic changes place higher demands on the land's productivity. First, aggregate growth in irrigated area has stagnated since 1979, partly because of a retrenchment in State investment in water control and growing operation and maintenance costs of the large and aging systems already in use. The lack of net growth in irrigated area means both irrigated and non-irrigated farms will be under even greater governmental pressure to become

more productive through increased and more efficient use of fertilizers. Second, agricultural research has continued to provide highly productive crops that respond to greater concentrations of fertilizer.

Perhaps more important, China's development pattern strongly suggests a shift toward more land-intensive food production. Caloric intake per capita is increasing rapidly, and large portions of this increase are composed of non-staple foods such as meats, aquatic products, milk, eggs, oils, sugars, and fruits and vegetables, which ultimately require more fertilizers to produce (see *The CBR*, November-December 1988, p. 20). Raising livestock, in particular, requires much more grain than is needed to supply equivalent calories via direct consumption.

Seeds of recovery

The long-term prospects continue to be good for both foreign fertilizer products and production equipment and technology. This conclusion rests on the fundamental dynamism of the rural economy, the decreasing ability of the central government to control it, and the necessity of any Chinese government, regardless of political orientation, to attach great importance to resolving problems with food supplies. But one can expect continued instability with both domestic fertilizer production and import contract behavior for the foreseeable future, as well as temporary problems in making timely contractual commitments, while governmental control is being consolidated. Ultimately, however, such delays sow the seeds of recovery, as governments that aspire to remain in power cannot ignore indefinitely the signs that crops need fertilizer to grow. Conversely, further erosion in central control would ultimately mean relatively independent provincial or local decision-making, and this in many locations would considerably enhance fertilizer import growth. 完