

Searching for Energy Security: The Political Ramifications of China's International Energy Policy

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China's growing energy needs combined with its limited domestic energy resources dictate that the country will become a player of growing importance on the international energy stage. The government has recognized the need to address a range of energy security issues but has yet to develop a coherent policy. China's policy has emphasized 'strategic' means to enhance security of energy supply rather than market mechanisms. The international components of this policy have contributed to China's increased diplomatic and economic involvement with energy-rich countries, especially in Asia. Examination of specific policies relating to Xinjiang, Central Asia, Russia, and the Middle East shows that decision-making is driven by a complex interplay of political, diplomatic, and economic factors. China's expanding energy interests need not necessarily pose a threat to the West or to its Asian neighbors—instead they can be used as an opportunity to integrate China into existing and new global and regional institutions.



In the late 1980s China was one of the world's largest net exporters of oil outside OPEC (Organization of Petroleum Exporting Countries). Imports accounted for less than 5 percent of annual oil consumption. On the eve of the Gulf War, oil imports were rising rapidly, but less than 3 percent of China's total annual supply was from the Middle East. It is no wonder that China could coolly abstain from the United Nation's Security Council motion that sanctioned the U.S.-led military action against Saddam Hussein. A decade on, China is set to become one of the world's major net importers of oil. Now some 30 percent of its oil needs are imported and more than 40 percent comes from the Gulf. Would China abstain from a UN vote under similar circumstances today?

The year that Saddam Hussein invaded Kuwait also saw the collapse of the Soviet Union. What had been a monolithic and threatening block along the northern and western borders of China became transformed into a collage of states offering a spectrum of diplomatic and economic opportunities. The last five years have seen the emergence of energy as a key plank of economic and political relations between China and its new neighbors. If the coming 20 years see the completion of even half of the projects under discussion, a new interdependence will have been created where only isolation and distrust existed before.

These developments have their roots in China's decreasing ability to provide its energy needs from domestic sources. The requirement to import energy is

set to grow for the foreseeable future and, thus, China is certain to become an even more important player on the international energy stage. From this follows the question of whether or not China's increasing energy needs pose a threat to the international community.

Nearly ten years have passed since China's oil companies made their first forays into overseas investment and five years since China began to seek energy opportunities in Central Asia and Russia. The common challenge for all China watchers observing these changes in China's energy policy is to understand what is happening within the black box of political decision-making at the highest levels of the Chinese government. In the absence of direct information, it has been necessary to await the accumulation of a few years of empirical evidence in order to begin unraveling the complex interaction of political and economic decision-making that shaped China's energy strategy.

This paper first analyzes China's evolving approach to enhancing its security of energy supply and then examines the interaction of energy policy and foreign policy in a number of case studies. The geographic focus of the study is continental Asia: Russia, Central Asia, and the Gulf. The reasons for this are fourfold:

- Most of the world's remaining supplies of oil and gas lie in these regions;
- Direct pipeline connections are possible from Russia and Central Asia;
- The major future growth of oil and gas imports to

China is likely to be from these areas; and,

- The geopolitical impact of China's involvement in the energy sectors in continental Asia is likely to be greater than in most other parts of the world.

THE ROOTS OF CHINA'S ENERGY SECURITY CONCERNS

Energy security is commonly understood as "the availability of energy at all times in various forms, in sufficient quantities, and at affordable prices" (UNDP, 2000). While it has some drawbacks, we shall base our account on this definition of energy security because we believe it is adequate and appropriate to examine the rationale behind China's energy strategies.¹ This section reviews the domestic roots of the Chinese leadership's energy concerns, which lie primarily in the imbalance between the current and projected domestic supply and the demand for energy.

The Growing Imbalance Between Supply and Demand

The potential vulnerability in the balance between energy supply and demand in China has its roots not so much in an absolute shortage of domestic primary energy resources, but rather in the mismatch between these resources and the nature of the growing demand for energy.

China is blessed with substantial resources of primary energy. It has the third largest reserves of coal in the world, a very large potential for hydroelectricity, and significant (but far from world class) reserves of oil and natural gas. At first glance it would be easy to deduce that China should have no energy security problem. However, such a conclusion would ignore a number of fundamental drawbacks in China's natural energy resource endowment.

Though coal has historically accounted for more than 70 percent of China's primary energy consumption (Sinton and Fridley, 2000), most of the country's coal is concentrated in the north of the country, far from the centers of demand. Much of the coal is of relatively low quality and a shortage of water in the main mining areas results in a low proportion of coal being washed. The consequent high levels of air pollution in China's towns and cities have been well documented (e.g., Smil, 2000; World Bank, 2001).

China's hydroelectricity resources also are geographically concentrated, found mainly in the center and southwest of the country. The last ten years have seen a massive program of investment in large-scale dams, of which the Three Gorges project is but the grandest. Whilst hydroelectricity can clearly make a substantial contribution to China's energy security, it has a number of severe limitations, for example the large size of capital

Table 1. China's Production, Consumption and Net Import of Oil and Gas

	2000	2010	2020
<i>Oil (mmt)</i>	<i>Actual</i>	<i>Estimate range</i>	<i>Estimate range</i>
Production	162	155-170-195	130-175-200
Consumption	227	270-300-350	350-400-550
Net Imports	70	75-150-230	130-250-400
<i>Gas (bcm)</i>	<i>Actual</i>	<i>Estimate range</i>	<i>Estimate range</i>
Production	28	55-65-75	95-110-130
Consumption	27	65-90-120	100-150-220
Net Imports	0	20-30	44-55-100

Sources: British Petroleum, 2001; Cordesmann, 1998; Downs, 2000; International Energy Agency, 2001; Jia et al., 1999; Medlock and Soligo, 1999; Zhou and Zhou, 1999.

mmt: millions of metric tons

bcm: billions of cubic meters

investment and long lead times, as well as the substantial social and environmental costs and risks.

China was self-sufficient in oil for more than 20 years from the early 1970s, when onshore production was established from a number of fields in northeast China, until the mid-1990s, when the rapidly rising demand finally overtook the static levels of domestic production. Despite the relatively generous endowment of oil in the ground, China's oil production is constrained by two key parameters: first, nearly all the oil has an intrinsic high cost of production, for geological reasons; and second, most of the "easy" oil has already been produced and production from the largest fields has reached a plateau or is already declining.

Natural gas always has accounted for less than 3 percent of China's primary energy consumption. The recent drive to enhance the use of natural gas has led to a spate of substantial discoveries. While huge reserves have been announced in the Chinese press, most of these gas accumulations suffer from the same geological problems as the oil fields and most lie in the far north and northwest of the country. These features will raise the cost of production and transportation. Despite these drawbacks, China continues to bring these discoveries to market as rapidly as possible, in part to mitigate the environmental impact of excessive coal use.

The Future Growth of Oil and Gas Imports

The need for oil products for road transport is the single most important factor driving China's increasing demand for oil, and this will continue to be the case in the short-term—say ten to fifteen years. A consensus among international and Chinese researchers indicates that annual oil demand is likely to rise from the present level around 200 million tons to 300 million tons by 2010, and to at least 400 million tons and possibly more than 500 million tons by 2020. (See Table 1).

Oil. It is widely accepted that China's domestic production of oil will reach a plateau in the next ten years, despite a sustained campaign over more than ten years to substantially increase output. Most projections for oil production levels in the year 2010 vary from 155 to 195 million tons per year, compared to 160 million tons in the year 2000. By 2020 production may fall below the level of 2010 unless major new discoveries are made.

A number of forecasts of net oil imports in the year 2010 made by non-Chinese specialists lie close to 150 million tons, which is similar to the predicted level of crude oil production in China at that time. Thus, China would be importing some 40 to 50 percent of its oil

requirements, compared to about 30 percent in the year 2000. Chinese estimates of net imports are substantially lower and range from 75 to 130 million tons. The absolute quantity of oil imports would almost certainly continue to increase during the following decade and could exceed 250 million tons by the year 2020—a level on par with Japan's current oil imports.

Natural gas. Since the mid-1990s the Chinese government has placed great emphasis on developing a domestic gas market. Forecasts of China's domestic production of natural gas show a considerable jump from 28 billion cubic meters in the year 2000 to 60-75 billion cubic meters by 2010 and more than 100 billion cubic meters in 2020. (See Table 1)

Gas consumption is expected to rise substantially from current levels just above 27 billion cubic meters to 75-100 billion cubic meters by 2010 and 100-200 billion cubic meters by 2020. Any forecasts of future gas consumption have to be closely tied to the availability of developed reserves, either domestic or overseas, and of transport infrastructure, either pipelines or liquefied natural gas (LNG). In addition, distribution infrastructure and gas-consuming appliances must be in place, for while oil consumption does not have such great infrastructure requirements, natural gas consumption is dependent on the infrastructure being in place.

The limited number of published projections places China's level of gas imports at 20-30 billion cubic meters per year by 2010 and double this amount, or more, by 2020. These projections are consistent with one major import pipeline being operational by 2010 and a second ten years later. The LNG project currently under construction in Guangdong Province has a planned capacity of 6.5 billion cubic meters by 2010. Unless China has some major political economic crisis, this LNG infrastructure will almost certainly be built. The main question is whether these projects will be built rapidly enough for these forecasts to be met.

THREATS TO CHINA'S ENERGY SECURITY

Events that can threaten the energy security of a petroleum importing state may be classified into two categories (see Table 2): (1) events that are of global impact, and (2) events that impact a specific country or region.

Global Events

Disruptive global events are of concern to all oil and gas importing countries. The most common of these is the policy discontinuity caused by OPEC policy decisions

Table 2. A Working Classification of “Energy Security” Events

Classification	Event
<i>Global Events</i>	
Policy discontinuity	Reduction in output by producers, producers raise prices
Fundamental discontinuity	Global shortage of production capacity
Force majeure disruption	Civil unrest, war, deliberate blockage of trade routes
Export disruption	Export cut-back by main exporters
Embargo disruption	Embargo by importers of a specific exporting state
<i>Domestic Events</i>	
Embargo disruption	General embargo of specific importing state, embargo of a specific importing state by a specific exporter or transit state
Logistical disruption	Accident or terrorist destruction, especially along transportation infrastructure
Local market disruption	By monopolist local suppliers, by pressure groups, or through government mismanagement

Source: This classification was expanded and modified from work by Horsnell (2000).

on output levels that are driven by a desire to raise or lower international crude oil prices. Such discontinuities are almost certain to occur every few years until better information on production and stock levels is available (Horsnell, 2000). The impact of such discontinuities is a relatively sudden and unpredictable change of oil prices.

A long-term failure throughout the world to invest in production, transportation, or processing capacity could result in an absolute shortage of supply of energy with respect to the global demand. This fundamental discontinuity is the most serious energy security threat facing the world today. Such an event would have a substantial impact on the economies of energy importing countries, particularly transition economies like China, and on the global economy. The shortages created by this failure to invest could create negative impacts that may last a number of years whilst the necessary capacity is constructed (Horsnell, 2000).

The remaining three events in the global category (e.g., *force majeure*, export and embargo disruptions, see Table 2) cover a variety of disruptions in or around the major oil and gas exporting states. Most of these types of events have their roots in political maneuvers, either of importing states or of exporting states (Horsnell, 2000).

These kinds of disruptions are unlikely to have a sustained detrimental impact on importers, for two reasons: (1) either because the interests of the party causing the disruption are being damaged, or (2) because alternative methods or trading and transport can be found (Lichtblau, 1994). In addition, a limited number of states (such as Saudi Arabia) have surplus production capacity and can rapidly raise output in times of crisis (Asia Pacific Energy Research Center, 2000). Only a major global or regional war could disrupt oil and gas supplies for more than a few months (May, 1998).

Domestic Events

What have been classified as domestic events (see Table 2) have the potential to cause much more damage to an importing country's energy supply than global events. These domestic events fall into three categories: (1) embargoes of various types, (2) physical disruptions, and (3) market disruptions.

A general embargo of a specific importing state, if effective, could bring a country to its knees very quickly. However, we believe that the probability is extremely low that a large number of states would agree to such an embargo and that this blockade would be effectively

implemented, especially in the case of a large country with a long coastline such as China. Again, such an event is only likely in a major regional or global war.

More probable than a general embargo is the deliberate disruption of an export flow by an exporting state or by a transit state. Such an action only has any meaning if applied to a pipeline rather than to shipping from a specific source. Ships can be diverted but pipelines are immovable. The exporting and transit states along a pipeline have some political leverage over the importing state. This leverage can be used to disrupt flows in the short term in order to increase the exporting or transit country's bargaining power in some political or economic negotiation with one or more of the other states involved. A disruption of this type is likely to be short-lived because the interests of the disrupting state also will be affected in respect to lost revenue—nonetheless such pipeline disruptions may be frequently used against China. Specifically, in the future, China could be susceptible to such threats from Central Asian states and Russia, as well as from Mongolia if any import pipelines run across this country.

Accidents and, to a lesser extent, terrorism, are endemic on some long-distance oil and gas transport routes, be they pipelines or sea-lanes. Good management of pipelines and shipping lanes could reduce the frequency and impact of accidents. Though persistent terrorist attacks on pipelines raise the cost of transport, sufficient monitoring and quick repair minimize interruptions in oil and gas flow. Petroleum pipelines from Central Asia are likely to be exposed to such threats, both within the Central Asian states and within the far northwest of China.

Events in the world over the last two years have highlighted a new source of energy supply disruption in the developed countries, but one which is not new to developing and transition economies—that is the disruption of local energy markets as has been seen in California. Such disruptions may have many causes, for example pressure groups, government mismanagement, and monopolist behavior. In China such threats could take the form of: (1) the deliberate restriction of energy supply by a state-run or private sector energy monopolist; or (2) a badly designed or poorly implemented program privatizing energy supply industries. Besides under-investment that leaves some areas underserved in terms of energy supply, there have not been major local disruptions in the flow of energy to Chinese consumers.

From this brief survey we conclude that domestic threats to energy supply may be just as important as those with a global origin. Indeed, in developing and transition

countries the domestic threats may greatly outweigh the international ones. In the case of China, international events currently only pose a potential threat to oil supply. But, when gas imports commence, these supplies too will be at the mercy of external threats. Within China, the production and the transportation of all forms of energy are susceptible to a range of domestic disruptions.

CHINA'S MEASURES TO ENHANCE ENERGY SECURITY

Measures Available

A government of an energy-importing country may invest in a number of measures to enhance the country's security of energy supply. These may be categorized either: (1) as measures to reduce the probability of a supply disruption, or (2) as steps to minimize the impact of supply disruptions or price rises (See Table 3). In simple terms, these measures may be characterized as reflecting a "strategic" or "market" approach to energy security. Long-term measures to reduce the probability of disruption also may be either strategic or market, but most long-term measures to are strategic in nature.

The strategic approach to enhance energy security would combine state-sponsored economic measures with political initiatives. Economic measures would include direct government participation in both enhancing domestic energy production and investing in overseas sources of energy. Political links with energy exporters would be of great importance, especially if supported by a range of economic measures such as aid, inward investment, and sales of key goods. Governments pursuing this approach might not be overly concerned about the cost of implementation compared to the probability and impact of the disruptive event.

The market approach would, in the extreme case, rely on national and international energy markets and would seek to reduce the risk of disruption by improving the efficient functioning of these markets. The last twenty years have seen a tendency for the world's largest economies to prefer a market approach for long-term measures to energy security (Mitchell, 2001). Thus recent reports on energy security issued by the U.S. government, the European Commission, and the Asia Pacific Energy Research Center have emphasized: (1) liberalization of domestic energy markets, (2) promotion of investment in new capacity, and (3) improved flow of information (Morse and Jaffe, 2001; National Energy Policy Development Group, 2001; Asia Pacific Energy Research Center, 2000; European Commission, 2001). The cost to the respective governments of establishing such markets should be relatively low.

Whether their supply-side focus is strategic or market driven, most governments also consider demand-side mechanisms to reduce vulnerability to supply disruptions. These may include: (1) enhancing energy efficiency, (2) seeking substitutes for oil, and (3) promoting public transport. (See Table 3). The mechanisms used to implement these measures to a great extent will depend on the nature of the domestic energy markets. Market mechanisms may be appropriate in a liberalized energy market, but a regulatory approach will be needed where the energy sector remains controlled by the government.

These long-term strategies to enhance energy security, whether based on markets or strategic mechanisms, should be supplemented by measures to address the short-term impact of an actual supply disruption or a price spike. The key steps are to establish emergency storage and to draw up an emergency response plan. Implementation of long-term energy strategies takes time, money and careful consideration of a number of issues (Asia Pacific Energy Research Center, 2000). With insights into measures that countries can adopt to enhance energy security, we now turn to specific strategies of China's

energy security policy.

China's Energy Security Policy

To date, the Chinese government has not produced an official public document outlining its policy for enhancing the security of energy supply. Indeed it can be reasonably claimed that a coherent energy policy in any form is lacking (Andrews-Speed et al., 1999). Therefore China's approach to energy security has to be deduced from its plans and actions. Over the past decade, China's four main policy objectives in the energy sphere appear to have been:²

- Maximize domestic output of oil and gas;
- Diversify the sources of oil purchased through the international markets;
- Invest in overseas oil and gas resources through the Chinese national petroleum companies, focusing on Asia and the Middle East; and,
- Upgrade and expand the infrastructure to bring this overseas oil and gas to Chinese markets.

Table 3. Strategic and Market Measures to Enhance the Security of Energy Supply

	"Strategic" Approach	"Market" Approach
<i>Supply-side economic measures to reduce the probability of disruption in the oil supply</i>	<ul style="list-style-type: none"> • Control through state companies • Self-reliance • Investment in domestic and overseas production and transportation 	<ul style="list-style-type: none"> • Liberalize energy markets • Integrate with international markets • Encourage domestic and international investment in production and transportation
<i>Demand-side economic measures to reduce the probability of disruption in the oil supply</i>	<i>Use administrative measures to:</i> <ul style="list-style-type: none"> • Increase energy efficiency • Adjust transport policy • Diversify transport fuels 	<i>Use market measures to:</i> <ul style="list-style-type: none"> • Increase energy efficiency • Adjust transport policy • Diversify transport fuels
<i>Measures to reduce the probability of disruption in the oil supply</i>	<ul style="list-style-type: none"> • Enhance political links with energy exporters • Outward investment and aid to energy exporters • Use military force 	<ul style="list-style-type: none"> • Promote the efficient functioning of international energy markets
<i>Measures to reduce the impact of disruptions to the oil supply</i>	<ul style="list-style-type: none"> • Strategic storage • Oil sharing • Emergency response procedures • Fuel switching • Surge capacity 	

Maximize domestic output. China's efforts to increase the domestic output of petroleum have met with mixed success. Whilst new discoveries of oil are barely managing to replace the production of existing reserves, a vigorous campaign of gas exploration has yielded new discoveries which can provide the platform for the development of an extensive domestic natural gas market.

Diversify sources. The 1990s saw China making a strategic shift in its sources of oil imports. In the early 1990s more than half of this trade came from the Asia-Pacific region, mainly Indonesia and Malaysia. As China became a net importer of oil it deliberately sought to raise the proportion of imports from the Middle East and other regions such as Africa and Latin America. Since 1997, China has established long-term supply arrangements with Gulf states such as Saudi Arabia, Iran, Oman, and Yemen. Despite the evident diversification that has been achieved, in effect China has swapped dependence on one region, Southeast Asia, for dependence on another, the Gulf. A newly planned oil pipeline from Russia, and a more speculative one from Kazakhstan, could somewhat counterbalance this over-reliance on the Middle East.

Invest overseas. Since the mid-1990s official and academic documents in China have proclaimed the virtues of China's petroleum companies investing in overseas oil exploration and production in order to secure supplies of crude oil, which could then be refined in China. The first projects in the early 1990s were generally far from China and had the character of experiments. Only in the late 1990s did sizable commitments start to be made, the largest of which were in Kazakhstan and Sudan. At the heart of this strategy lies the recognition that a belt of untapped oil and gas reserves in Russia, Central Asia, and the Middle East surrounds China. In all three regions, considerable potential exists for further discoveries especially in Central Asia and eastern Russia, which are relatively lightly explored.

With the exception of the petroleum resources in the Middle East, all this oil and gas production could be delivered to consumers in central and eastern China via pipeline. For this reason Chinese investment activity has been focused on Central Asia and Russia. Oil from the Middle East and other remote regions could be shipped directly to China along a supply chain that could be under Chinese management from start to finish. Together these pipelines and shipping routes would, supposedly, substantially reduce China's exposure to disruption in the international markets and from military blockades.

Improve delivery infrastructure. As part of the strategy to enhance the effectiveness of the energy sector, the Chinese government for several years has been spending substantial sums of money on upgrading and expanding the domestic transportation networks for coal and electrical power. A key objective is to have a completely interconnected national power grid by the year 2010.

These four key energy policy objectives clearly indicate the Chinese leadership's preference for a strategic approach to enhance energy security. Despite concerted efforts to pursue the above four policy areas, little sustained progress has been made on implementing other proposals to enhance China's security of oil supply, such as: (1) constraining the demand for oil; (2) deregulating the internal oil markets; and (3) putting in place emergency response measures.

The Chinese government has taken few steps to constrain growth rate of oil demand, despite recommendations to do so through conservation, efficiency, and substitution. Political pressures and high international oil prices have constrained the government's plans to impose higher taxes on transport fuels and thus consumer prices for gasoline and diesel are arguably too low to encourage savings or the use of more fuel-efficient vehicles.

Further evidence of the low prioritization for market strategies is that in China progress in liberalizing the energy sector has been hesitant. In 1998, the Chinese government carried out a major restructuring of the government agencies and of state companies in the energy sector, as well as set up a mechanism to ensure that domestic oil prices more closely reflected international market prices. However, these measures resulted in little genuine liberalization of the domestic energy sector (Andrews-Speed et al., 2000). Most energy production, transportation, and supply are controlled by companies owned by the state at different levels of government, which resist losing control of their lucrative monopolies. Energy prices still are set or constrained by government agencies, as are import and export quotas.

The Chinese leadership also appears to have neglected to put into place contingency measures to cope with a sudden disruption of oil supplies, despite calls by Chinese academics and policy advisors to do so. In June 2001 the Chinese government announced plans to develop a strategic oil reserve of 6 million tons by 2005 and 15 million tons by 2010. These quantities amount to barely more than one month of projected net oil imports and fall far short of earlier proposals to build the reserve at almost twice this rate.

This review of China's energy security policy has shown that the government has placed the greatest emphasis on three of the policy objectives: (1) maximizing domestic production of oil and gas, (2) diversifying sources of imports, and (3) investing in overseas production. As will be shown in the next section, these steps have been accompanied by a deliberate policy to enhance political and economic links with oil and gas exporting states. This combination of measures is characteristic of a "strategic" rather than a "market" approach to energy security. Moreover, the current policy for enhancing the country's security of energy supply may be reasonably characterized as *ad-hoc* and incomplete (Manning, 2000).

CHINA'S INTERNATIONAL ENERGY POLICYMAKING

The aim of this section is to examine China's involvement in the international energy arena in order to reveal the interaction between energy policy and foreign policy. We begin by reviewing the identity and presumed priorities of the institutions involved in these two key areas of policymaking. We then present four examples of major policy decisions and their subsequent implementation, in Xinjiang, Kazakhstan, Russia, and the Gulf. Each example shows a different balance of energy policy or economic concerns and foreign policy or political concerns. Xinjiang is included in the analysis because the investment and security decisions involve both energy policy and foreign policy considerations, and energy policy toward Xinjiang has implications for China's involvement in Kazakhstan and Russia.

The Actors and Their Priorities

For the purposes of this analysis, the policy priorities of China's main actors will be grouped under just three headings: foreign policy, general domestic policy, and energy policy. Under foreign policy come such concerns as national security and sovereignty, China's regional influence and China's great power status in the world. The focus of domestic policy is political and social stability, for which sustained economic growth is required. Economic growth requires energy, and thus energy security is a key component of overall energy policy. A second dimension of energy policy, which is currently of secondary importance in China, is the profitability of Chinese energy companies. The main actors in China's international energy policymaking include:

- The top leadership of the Communist Party and government;
- The military;

- Key government departments and ministries; and,
- State petroleum companies.

The top leadership of the Party and government. All major policy decisions concerning domestic or foreign policy are discussed and endorsed by the very highest levels of the Communist Party and the government. The two key central government bodies are the Standing Committee of the Politburo and the State Council (Lieberthal, 1995). The former tends to be more concerned with political issues whilst the latter is heavily involved in economic matters. Decisions relating to international energy policy involve a complex range of domestic and foreign policy issues. Therefore, all major decisions concerning China's international energy policy require the support and confirmation from these two top leadership bodies. The foremost concerns of both the Politburo and the State Council are likely to be political and social stability, national security, sovereignty and international influence. Energy security *per se*, or indeed any aspect of energy policy, will only become a priority if a subordinate government agency has drawn it to the attention of the State Council.

The Chinese military. The role of the Chinese military—the People's Liberation Army (PLA)—is not only to protect China's national security, but also to ensure the Communist Party's leadership. Thus, the only field of great military influence is security policy (Swaine, 1997). The PLA's ability to affect China's foreign policy may well be greater under Jiang Zemin than under Mao Zedong and Deng Xiaoping, but this only becomes evident in crisis situations. Given that China possesses sufficient domestic energy resources to support the PLA in a major war, we consider that the military probably plays a relatively minor role in the formulation of international energy policy. However, the PLA may well be more involved at a later stage if there are expensive energy assets to protect, either on Chinese soil or overseas.

Key government agencies. A number of government agencies are involved in international energy policymaking. Those with a primary concern for energy supply include some departments of the State Development Planning Commission (SDPC) and the State Economic and Trade Commission (SETC). Together these two agencies formulate general economic policy and draw together the key components of energy policy (Lieberthal and Oksenberg, 1988; Andrews-Speed et al., 2000). Security of energy supply is a major concern to both SDPC and SETC, especially since China became a

net importer of oil. In addition SDPC is required to approve all major investment decisions and SETC has a range of day-to-day management responsibilities for the state petroleum companies.

Two other departments with a subordinate role to play are the Ministry of Foreign Affairs (MFA) and the Ministry of Foreign Trade and Economic Cooperation (MOFTEC). MFA plays a role in China's foreign policy process with mainly three functions: (1) to provide information to the top leadership, (2) to make decisions on routine foreign affairs, and (3) to implement the policies made by the top leadership. Prior to the reform era, MOFTEC played a minor role in setting China's foreign policy. However, following China's increasing interdependence with the outside world, and especially with China's efforts to enter the World Trade Organization (WTO), the importance of MOFTEC in foreign and energy policymaking has grown in recent years.

State petroleum companies. The final group of actors is the state petroleum companies. Though nominally subordinate and separate from the government, the state petroleum companies have considerable power and influence based on their importance to the national economy and near monopoly status. This power monopoly continues despite the 1998 government reorganization (Andrews-Speed et al., 2000) and their current status outside government departments or ministries. The main actor is CNPC, together with its partly floated subsidiary, PetroChina. Whilst both entities are under pressure to maximize their profits, this is likely to be more seriously enforced at the partially privatized PetroChina. Conversely, CNPC is more susceptible than PetroChina to government pressure to address issues concerning energy security. CNPC also plays the leading role in China's overseas petroleum investments.

THE CASE STUDIES

Xinjiang: The West-to-East Gas Pipeline

Over the past twenty years, CNPC, and latterly PetroChina, have made a steady series of oil and gas discoveries in the Tarim Basin, which lies in the southwestern part of Xinjiang Autonomous Region. However, the central government has shown no great enthusiasm to support the major investment needed to develop the Tarim Basin fields and to transport this oil and gas to the markets in the east of the country. The main reasons hindering such investment have been the high costs of exploration, development, and transportation, which make these reserves relatively

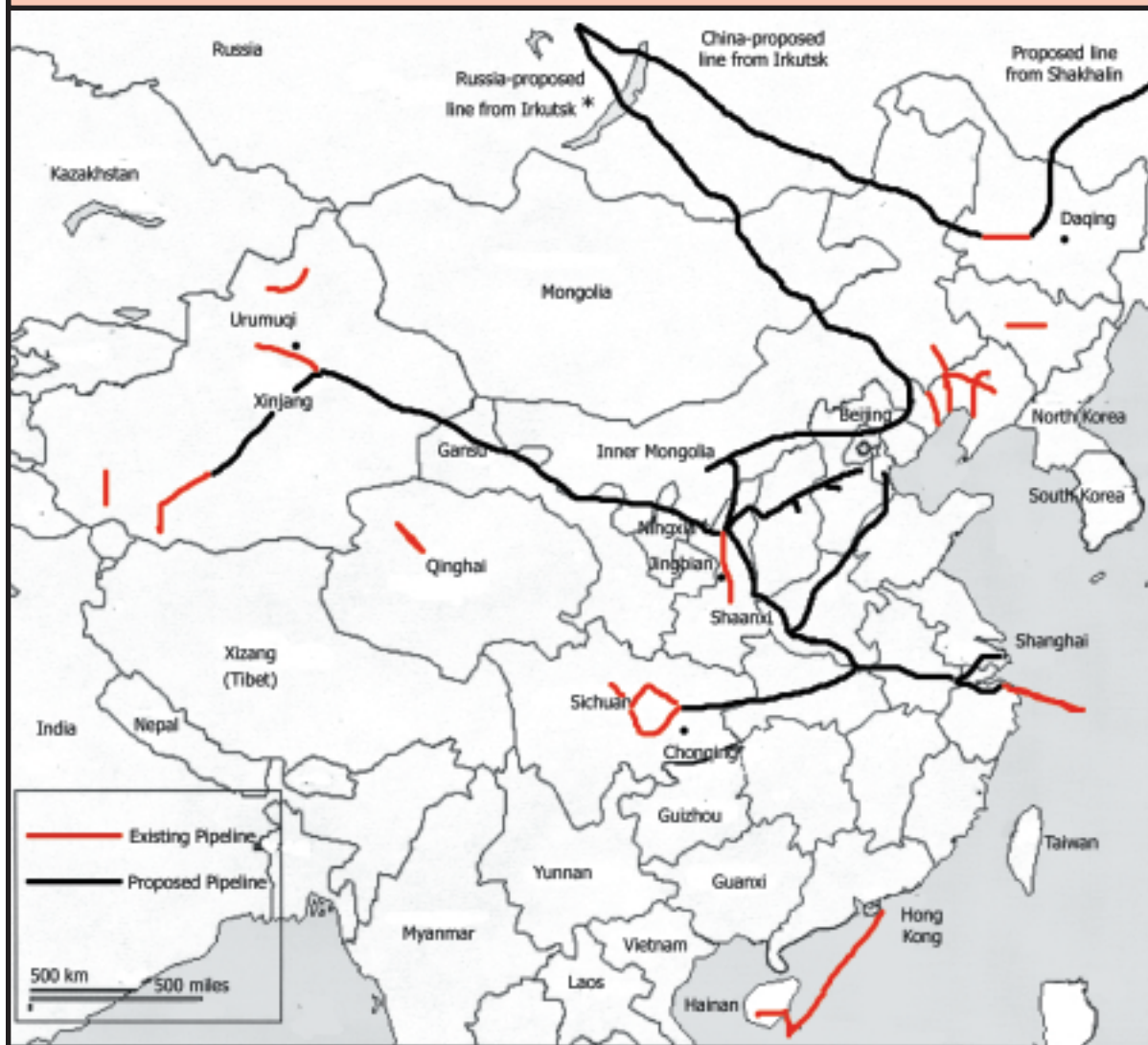
uncompetitive. The government's decision in the spring of 2000 to go ahead with the "Develop the West" campaign and to include within it the west-to-east gas pipeline network from Xinjiang to Shanghai marked a sharp shift from the previous energy development priorities in Xinjiang. This shift in policy can most likely be attributed to a remarkable convergence of economic, political, domestic, and foreign policy interests.

Xinjiang has great political significance for the Chinese government leaders for two reasons. First, it borders the newly independent states of Central Asia where China wishes to have a presence in order to counter-balance the increasing U.S. influence in the region. Second, the large Muslim population poses a potential threat to Beijing's control over Xinjiang. Therefore the central government is liable to seize on any instrument that will project its influence and assert its authority in this remote and under-populated part of the country (Ferdinand, 1994).

The Develop the West campaign sprang from the central leadership's fear of the social and political consequences of the widening economic divide between the booming coastal regions of eastern China and the stagnating central and western regions. Xinjiang is clearly one of the targeted provinces and thus should benefit from these investments. At the campaign's core is a broad range of infrastructure projects, of which the west-to-east gas pipeline is just one. (*Editor's Note: For more details on the Develop the West campaign see Elizabeth Economy's paper in this issue of the China Environment Series*)

In addition to these political considerations, three energy-related factors probably helped to seal the decision to go ahead with the west-to-east pipeline (see Map 1 for information on completed and projected natural gas pipelines). First was the pressing need to bring on stream substantial supplies of natural gas to support the policy of promoting gas use in China. The first wave of supply could be sourced from the Ordos Basin of north China. The key question was whether the next wave of gas supply would be from east Siberia (the Kovytko field near Irkutsk), which is widely accepted to be potentially profitable, or from the less commercially viable Tarim Basin. Political and contractual problems, which promised to delay the former project and the greater security of supply from the latter project, have acted to swing decision-makers in favor of the Tarim Basin. Secondly, CNPC and PetroChina have lobbied the central leadership and key ministries hard to be allowed to recoup some of their 20 years of exploration investment in the Tarim Basin. Finally, by taking the west-to-east pipeline all the way to the coast, the Chinese government could

Map 1. China's Projected and Existing Natural Gas Pipelines



* This route may be used for natural gas or oil

Source: Dong Xiucheng and Jeffery Logan (2002). "Expanding Natural Gas Use in China: A Joint Sino-U.S. Research Reprt." Paper Published by Pacific Northwest National Lab and University of Petroleum-Beijing [On-line]. Available: <http://www.pnl.gov/china>

fairly claim that the Develop the West campaign was providing a direct benefit to the coastal provinces through the provision of clean energy.

This analysis shows that the decision to construct the west-to-east gas pipeline was not based on purely energy concerns. Energy security and the interests of state petroleum companies (e.g., CNPC and PetroChina) by themselves may not have provided adequate justification for going ahead with this major pipeline project. Consensus among the major actors could only be reached when the role of the pipeline could be set in a wider context of domestic, security, and foreign policy.

Kazakhstan: Oil Fields and Pipelines

After the collapse of the Soviet Union in 1991, China rapidly established diplomatic relations and signed a series of agreements on bilateral economic cooperation with the new states of Central Asia. In 1997 CNPC won the right to develop two oil fields in Kazakhstan and undertook to construct a pipeline to export oil eastwards to China. Six years on, little substantial progress has been made on any of these projects, which is symptomatic of the context in which these commitments were made. It is our contention that China's move into Kazakhstan's oil sector was driven as much, or more, by political

considerations than by energy concerns (Andrews-Speed and Vinogradov, 2000).

China's political and strategic interests in Central Asia spring from a number of intertwined fears. Xinjiang's Muslim minorities have strong ethnic and political links with the populations of neighboring states, especially in Kazakhstan which hosts groups active in supporting autonomy in Xinjiang. The Chinese government has devoted considerable energy to persuading the Kazakh government to discourage these groups (Burles, 1999).

Further security cooperation between China and the Central Asian states took two forms (Calabrese, 1999). First came a series of bilateral agreements in which China resolved long-standing disputes on the alignment of its borders with Central Asian states. Second was the creation of the "Shanghai Five" group (comprised of China, Russia, Kazakhstan, Kyrgyzstan, and Tajikistan), which aspires to enhance military cooperation and political stability in the region. In June 2001 with the inclusion of Uzbekistan, the group was renamed the "Shanghai Cooperation Organization" (SCO). Through these cooperative mechanisms China has sought to reduce the separatist threat, to enhance the security of its western borders, and to counterbalance growing U.S. influence in Central Asia.

Kazakhstan has large proven reserves of oil and new discoveries are being made each year. The main problem is exporting this oil to markets thousands of kilometers away. The Kazakh government would therefore have been keen to make energy a key component of economic cooperation with China and to include an eastward-flowing pipeline in any framework agreement. Although investment in overseas petroleum resources was a key facet of China's energy security strategy in the 1990s and Kazakhstan was an immediate neighbor from whom oil could be imported directly by pipeline, the main obstacle to a pipeline has been the cost. An oil pipeline running 6,000 kilometers from Kazakhstan to eastern China makes little commercial sense, when the alternative is to buy from the international markets and have the oil delivered by ship to the coast. The decision to go ahead with the commitment to invest in two fields and to construct the pipeline was probably driven by two forces:

- Political and security concerns surrounding the region persuaded the top Chinese leadership to support the development of strong economic links between the two countries; and,
- CNPC expected to see substantial benefits flowing from the development of this overseas production as well as from the construction of the pipeline, which

among other things would allow them to develop more of their marginally commercial oil fields in the Tarim basin.

A number of events and considerations have conspired to delay progress on these projects. First was the sudden fall of international oil prices in 1997 that made all petroleum investments in Central Asia look unattractive. Then came the reorganization of China's petroleum industry in 1998, which gave CNPC the opportunity to invest in a range of more attractive activities within China that had previously been off limits, such as oil refining and marketing and gas distribution. An increasing emphasis on the need to make profits further reduced CNPC's enthusiasm for its Kazakh projects. Finally, CNPC was becoming increasingly frustrated at the administrative and fiscal obstacles it was encountering doing business in Kazakhstan.

For these reasons it could be safely stated that by the middle of 2001 economic reality undermined politically driven enthusiasm. Thus, CNPC's investment plans in Kazakhstan were dormant and nearly dead. However, the events of September 11th have triggered a reevaluation and a growing prioritization of energy security by the Chinese leadership, who may yet decide that the current dependence on the Gulf for oil supplies is excessive and that the Kazakhstan oil pipeline should be constructed, regardless of the cost.

Russia: A Source of Oil and Gas

The last ten years have seen a remarkable improvement of relations between China and its erstwhile adversary, Russia. Facing the United States as the only superpower in the post-Cold War world, Beijing and Moscow regard themselves together as the only available counterweight against U.S. hegemony. The two countries established a "Constructive Partnership" in 1994, and then up-graded it into "Strategic Partnership" two years later. Arms sales continue to comprise one of the most significant activities in Sino-Russian strategic cooperation (Blank, 1997). In addition, the defense ministers from the two countries meet regularly and Russian defense scientists and technologists work within China's arms industry (Ferdinand, 1997). This rapprochement between China and Russia culminated in the signing of a treaty of friendship and cooperation in July 2001. In addition to geopolitics, national security and economics form the foundation of this partnership.

National and regional security is significant for Sino-Russian cooperation, especially in Central Asia and Northeast Asia. The participation of both parties in the

Shanghai Cooperation Organization reflects their common concerns with Islamic fundamentalism and potential instability in Central Asia. In terms of regional security, China and Russia have worked with the United States and Japan to reduce tensions in Korean Peninsula.

The economic component of this partnership, trade and investment, has developed at a slow pace, with the exception of the arms sales mentioned above (Rozman, 1998). Energy is the only sector that has the potential to provide prolonged and substantial mutual benefit. Eastern Siberia and the Russian Far East possess vast untapped accumulations of oil and gas, which are far larger than can be consumed by the declining local population. The nearest market for these fields is Northeast Asia, including Korea, Japan, and China (Paik, 1998; Andrews-Speed, 1998). But only China has the potential to provide a large market in the relatively near future. Oil and gas exports promise to address the desperate need for Russia to raise both its GDP and its exports, and to improve its balance of trade with China, as well as fulfill the desire of both parties to underpin their strategic partnership with economic cooperation.

Natural gas pipeline projects. In the long term, gas will be the main fuel to flow from Russia to China. (See Map 1) The Kovytko fields near Irkutsk have been under evaluation by British Petroleum (BP) and CNPC for more than five years, with the idea of transporting the gas by pipeline to northeast China. To the northeast of Irkutsk lie the potentially vast, by not fully proven reserves of the Sakha Republic. Additional sources of gas exist in the Sakhalin region (though these are currently not destined for China) and in west Siberia where a pipeline running into northernmost Xinjiang has been proposed. Despite the political desire for one of these gas projects to go ahead, little progress to develop them has been made. As mentioned above, these plans were overtaken by the decision to build the domestic west-to-east gas pipeline. However, the prioritization of the domestic pipeline did not preclude the involvement of Russia's Gazprom in the west-to-east pipeline, China's first long-distance gas transportation project.

Oil pipeline projects. It appears that little attention was paid to the possibility of constructing an oil pipeline from Russia to China until late 2000, when Russian officials and oil companies put forward suggestions for export pipelines from western and eastern Siberia. In July 2001, hot on the heels of the treaty of friendship and cooperation, an agreement was signed between Chinese and Russian parties to construct an oil pipeline. This

would run from the oil fields of Angarsk—by chance also near Irkutsk in East Siberia—eastwards to the Daqing oil field in Heilongjiang Province in the far northeast of China. (See Map 1) Such a routing has a number of advantages to the Chinese parties: (1) This route avoids Mongolia and thus the risks that any pipeline runs when crossing third countries; and, (2) The pipeline will be connected directly into existing infrastructure at the Daqing field.

Since the 1960s, Daqing has underpinned China's oil industry, but production has been on decline. It is both economically and politically advantageous that the oil imported from Russia will progressively displace Daqing oil in both pipelines and refineries in northeast China. Such an arrangement will prevent a rapid closure of these oil facilities, which would have created economic losses for CNPC and PetroChina and create an incremental unemployment burden for local and central governments. In addition, the use of existing infrastructure will reduce the lead-time and the capital investment needed for the project. Thus the first major cooperative energy project between Russia and China is not only consistent with the growing strategic partnership between these two states, but also addresses a number of specific political and security concerns of key government and top leadership actors in China.

The Gulf: A Crucial Source of Oil

China's relationship with the Gulf region, though currently of the greatest importance with respect to energy imports, is arguably the most straightforward to explain even given the number of countries involved. In simple terms, China's growing economic and political involvement in the Gulf is driven primarily by the desire to deepen relations with the world's major oil exporters and to contribute to the enhancement of political stability in a region which provides for more than 40 percent of China's oil imports.

China's attitude toward the Middle East has tended to resemble that of a disinterested bystander (Schichor, 1998). Despite a belated drive to establish diplomatic relations across the region in the 1980s and early 1990s, China's involvement was limited principally to the export of labor, manufactured goods and arms, and the import of limited quantities of oil. By the mid-1990s China had become a net importer of oil, and the Chinese government and state companies were taking steps to establish closer relations with the governments and oil companies in the Gulf region (Calabrese, 1998). Long-term supply arrangements were concluded with Saudi Arabia, Iran, Oman, and Yemen, and CNPC committed to field

development projects in Iran and Iraq. Sensitive to the ambitions of Gulf states to secure a foothold in the refining and marketing sector of East Asia, China agreed to the principle of Saudi Aramco.³ becoming involved in joint ventures in China, though nothing has come of this five years on.

The Gulf's increasing importance for China's energy supply is necessarily accompanied by the Chinese leadership's enhanced concern with political and security dimensions of this turbulent region (Yang, 1998). Two issues are relevant to this discussion. First, China is becoming a more vocal participant in the global search for stability and peace in the region. On the one hand this reflects a requirement for uninterrupted supplies of oil and, on the other hand, China's increased involvement in the region is part of the overall ambition to counterbalance the U.S. and western primacy in the Gulf. Second, the Chinese government sees the Middle East as one potentially dangerous source of inspiration and assistance to Muslim separatists in Xinjiang.

China's increasing dependence on Middle Eastern oil has raised one more specter, that of the disruption of sea-lanes, either in the Gulf or in Southeast Asia. China is concerned that sea-lanes might be blocked either by local conflicts or by a deliberate embargo targeted at China. Conversely, some Western commentators have expressed the fear that China could use the need to protect sea-lanes as a front for aggressive expansion and projection of its blue-water navy. Two critical choke points lie on the route from the Gulf to China: the Straits of Hormuz and the Malacca Straits. Though no way exists to bypass the former, most of the world has a vested interest in keeping these straits open, and China can contribute little militarily to this effort. The Straits of Malacca could easily be blocked, by accident or intent. However, such an event would not be fatal, for only a few extra days sailing would be required of tankers en-route to East Asia.

In summary, China's involvement in the Gulf is driven principally by economic interests, of which energy is the most important. Most, but not all, of China's political activity derives from this increasing dependence on the region's oil supplies. Subsidiary facets of China's political engagement in the Gulf reflect the Chinese leadership's perennial desire to diminish the U.S. power monopoly in any key region of the world and to limit Islamic extremism within China's northwest region.

CONCLUSION

China's energy security policy is currently dominated by a limited range of strategic measures which are intended to reduce the probability of a disruption to oil and gas

supplies. The major components of this approach are: (1) to maximize the production from domestic energy resources, (2) to invest in overseas petroleum reserves, and (3) where possible, construct infrastructure to transport this oil or gas to China. At the same time the Chinese government has diversified the sources of its oil imports, which has had the effect of increasing China's reliance on the Gulf. Little effort has been made to develop measures to reduce the impact of a disruption by constructing a strategic reserve or draw up comprehensive emergency response plans; nor has sustained progress been made in liberalizing the energy sector and in introducing market measures which might reduce the probability of disruption. However the events of September 11th and China's accession to WTO may well nudge the Chinese government to address these important components of energy security.

The international agreements and investments we have described in this paper have formed an important part of China's energy security policy since the mid-1990s. Despite the often hasty commitments to make large investments in development and transportation projects, actual implementation has been cautious. The examples of Xinjiang, Kazakhstan, and Russia show that major investment only proceeds if a wide range of political and economic considerations and interests have been satisfied. Some projects may or may not be commercially, but the Chinese government appears to take great care to ensure that overall net benefit flows to China. In the three cases highlighted above, the evaluation of net benefit included: (1) domestic politics and security, (2) foreign, economic, and energy policy, and (3) the specific interests of the state petroleum companies. Only in the Gulf case does the need to secure energy supplies appear to be the main driving force for China's involvement, and political questions have been relegated to a supporting role.

A critical question emerges from this analysis. Namely, does China's "strategic" approach to energy security and the intimate interdependence between its energy policy and its foreign policy pose a threat to the West? The realist view of China's energy policy would emphasize the threat and the increasing probability of conflict. Competition for scarce energy resources, China's need to defend overseas energy supplies and transport routes, the developing strategic partnership with Russia, and China's greater involvement in the Middle East all have the potential to threaten western interests.

A liberal "engagement" view would focus on the possibility that China's energy needs will instead draw the country into greater cooperation and interdependence with the rest of the world. Energy resources will not be

scarce as long as prices are sending the right signals to encourage investment in new production capacity. Conflict driven solely by energy need is most improbable. China is not like Japan 60 years ago, for it has substantial energy resources of its own, and the nature of energy markets has changed considerably over the past six decades. The newfound friendship between China and Russia could be a force for interdependence and for regional stability in Northeast Asia and Central Asia, and need pose no threat to the West. Finally, China's priority in the Middle East is for stability so that its energy supplies are not interrupted. China has no interest in acting as an *agent provocateur* in this sensitive region.

We tend to evaluate China's energy policy through the liberal lens, though we recognize elements of truth in the realist analysis. The challenge for the West is to help and encourage China to take a cooperative approach in the international dimensions of its energy security policy and to integrate its domestic energy markets with the international markets. China has already begun dialogues with two key international energy institutions, the International Energy Agency and the Energy Charter Treaty secretariat. In addition it is desirable that the nations of Northeast Asia develop their own regional institution for energy security management.

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economic and political questions; and (2) it ignores the environmental dimension that has become increasingly considered to be an important aspect of energy security.

ENDNOTES

¹ Two major drawbacks of this definition include: (1) the adjectives “sufficient” and “affordable” beg fundamental

² For discussions on China’s energy policy priorities see Yan and Yang, 1999; Zhou, 1999; Li and Li, 2000; and Chen 2001.

³ Saudi Aramco is the major state-run oil company in Saudi Arabia.

250 CHINESE NGOs: Civil Society in the Making



This special report is the result of a yearlong research project funded by the Canadian International Development Agency and the British Foreign and Commonwealth Office. Based on visits and interviews throughout China, the report includes page-long profiles of each organization. In a sector widely believed dominated by government proxies, special emphasis was placed on identifying and profiling independent groups established by private citizens. An 8,000 word introductory essay by *China Development Brief* editor, Nick Young, describes the context of nongovernmental activity in China and analyzes the challenges facing independent organizations. This can be viewed, free of charge, on the *China Development Brief* Web site: www.chinadevelopmentbrief.com

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Praise for 250 Chinese NGOs:

China Development Brief has done us all a great service by pulling together this analysis of some of the major NGO groups in China. Based on wide-ranging fieldwork, '250 Chinese NGOs: Civil Society in the Making' gives us first hand insights into the depth and the range of the new groups emerging in China. The growth of these social organizations is contributing to new ways of thinking about and working on the many challenges facing China's development. The report is a valuable tool for helping us to understand what is happening.

Andrew Watson
Ford Foundation Representative for China

The China Development Brief team has been able—once again—to deliver a fine product that will be of interest to all those interested in civil society and in development. The document does, indeed, provide evidence that there is a significant, emerging community of Chinese NGOs. It also allows these organisations to be better known, and in this sense provides a practical and useful tool to all, Chinese or friends of China, including the international development cooperation community, who are keen to collaborate with such organisations.

Henri-Paul Normandin,
Counsellor, Head of Development Section,
Canadian Embassy, Beijing

Pesticides in China: A Growing Threat to Food Safety, Public Health, and the Environment

By Jessica Hamburger

Over time, pesticides tend to create more pest problems than they solve, causing increased crop losses as well as health and environmental damage. While Chinese farmers bear the brunt of illnesses caused by the country's growing reliance on pesticides, the world's consumers are also at risk. The Chinese government has banned some of the worst pesticides, but overall use continues to climb. Efforts to reduce pesticide use or even ensure quality control have been undermined by conflicts of interest inherent in the agricultural extension and pesticide supervision systems. Government agencies have pursued a variety of schemes to promote the production of food with little to no pesticide residues, but this work affects only a small proportion of the total food supply. The Chinese government needs to take bold and decisive steps to free Chinese farmers from the pesticide treadmill and improve the safety of its food.



Consumers around the world are used to seeing the “Made in China” label on everything from T-shirts to toys. What they may not know is that their fruits and vegetables are increasingly “Made in China” as well. More than likely, this produce contains the residues of pesticides that also are made in China. While Chinese farmers bear the brunt of illnesses caused by the country's growing reliance on pesticides, the world's consumers are also at risk. Globalization of the food industry spreads the risks of China's heavy reliance on pesticides, but it also creates incentives for China to minimize pesticide residues in food in order to maintain access to foreign markets. In this paper I will describe trends in Chinese food production and pesticide use and explore ways in which international investment, trade, and cooperation have influenced them. I also will put forward some recommendations for future actions within China and abroad that could contribute to more sustainable farming practices and the production of healthier food in China.

FOOD PRODUCTION TRENDS IN CHINA

Chinese food production has surged over the last two decades. The increase in food supply has exceeded the growth of domestic demand, allowing China to raise living standards and reduce poverty. Chinese farmers also have burst onto the global food production scene, giving stiff competition to growers who have traditionally dominated

world markets. However, China's entry into the strictly regulated food markets of Europe, Japan, and the United States will be constrained by the ability of Chinese farmers to reduce pesticide residues.

The huge advances in China's productivity began when Deng Xiaoping's pragmatic government began to free farms from agricultural communes and allowed them to partially privatize their agricultural production under the household responsibility system in 1980 (Zhou, 1996). The local government retained title to the land and farmers still had to produce and sell a certain amount of key crops (such as grain and cotton) to the government at low fixed prices. Once they had met their quotas, however, farmers could manage their land as they chose and produce vegetables and cash crops for sale on the free market. When market controls for perishable products were lifted in 1984 (Nyberg and Rozelle, 1999), Chinese farmers leapt at the chance to increase their income, and both sales and consumption of fruit, vegetables, eggs, and meat rose dramatically. The total output value of Chinese fruits and vegetables reached \$42 billion in 2000 (FarmChina.com, 2000).

China's share of the world's agricultural trade has increased during the reform period, and the value of its agricultural exports reached \$20.2 billion in 1997. Horticultural products—mostly fruits and vegetables—accounted for 31 percent of the total agricultural 1997 exports from China (Nyberg and Rozelle, 1999).

According to Chinese government estimates, exports rose to the point where China had captured one-third of the world's vegetable export market in 2000 (FarmChina.com, 2000). China increased its production of canned fruits, preserves, and fruit beverages by 50 percent between 1994 and 1997, and has become Japan's primary supplier of canned peaches (Johnson, 2001).

In the past, Chinese vegetables were exported only to Japan, Korea, Hong Kong, Macao, and Taiwan. Today, however, Chinese vegetable exports reach Southeast Asian and European markets and processed agricultural products, like apple juice concentrate, have made significant inroads into U.S. markets (FarmChina.com, 2000; Naegely, 1998). The recent surge in Chinese fruit and vegetable production has affected U.S. growers by edging them out of important Asian export markets. For example, Washington State's apple exports to Indonesia declined by 80 percent after China quadrupled its apple production between 1990 and 1997 (Naegely, 1998). California growers also face increasing competition with China for sales to Asian countries, which account for more than half of the state's agricultural exports (Johnson, 2001). California farmers even face competition from China for some fresh produce markets in their own backyard. For example, U.S. imports of Chinese garlic surged from 3 million pounds a year in 1992 to 64 million pounds a year—almost half the U.S. market at the time—in 1994, before being slapped with a huge anti-dumping tariff (Mendoza, 2002).

Threats to Sustainable Agriculture

Despite these production and export successes, Chinese agriculture still faces daunting challenges. The most urgent problem is the water table beneath the North China Plain, which fell by nearly 10 feet on average in Hebei Province in 2000, according to a study by Beijing's Geological Environmental Monitoring Institute (Brown, 2001). Farmers around Beijing now must drill down over half a mile to reach water. The government even is considering diverting water from the Yangtze River to parched farmland hundreds of miles to the north, a project that will cost tens of billions of dollars and displace hundreds of thousands of people (Brown, 2001). Desertification, salinization, soil erosion, overgrazing, and industrial pollution also constitute major threats to China's farmland. Fighting the loss of prime farmland to road and housing construction is another ongoing struggle for the national government, which has passed laws requiring farmland losses to be made up with expansion of farmland elsewhere. This expansion of farmland often has the unfortunate effect of bringing highly erodible

forests and grasslands into production, causing further loss of farmland to erosion.

Also high on the list of agricultural woes is the contamination of farms and the environment with chemical fertilizers and pesticides. Excessive application of fertilizer has contaminated groundwater with nitrates and caused toxic "red tides" of algal blooms and eutrophication of lakes and rivers, while throughout China pesticides have killed the natural enemies of crop pests and poisoned farmers and consumers (Nyberg and Rozelle, 1999).

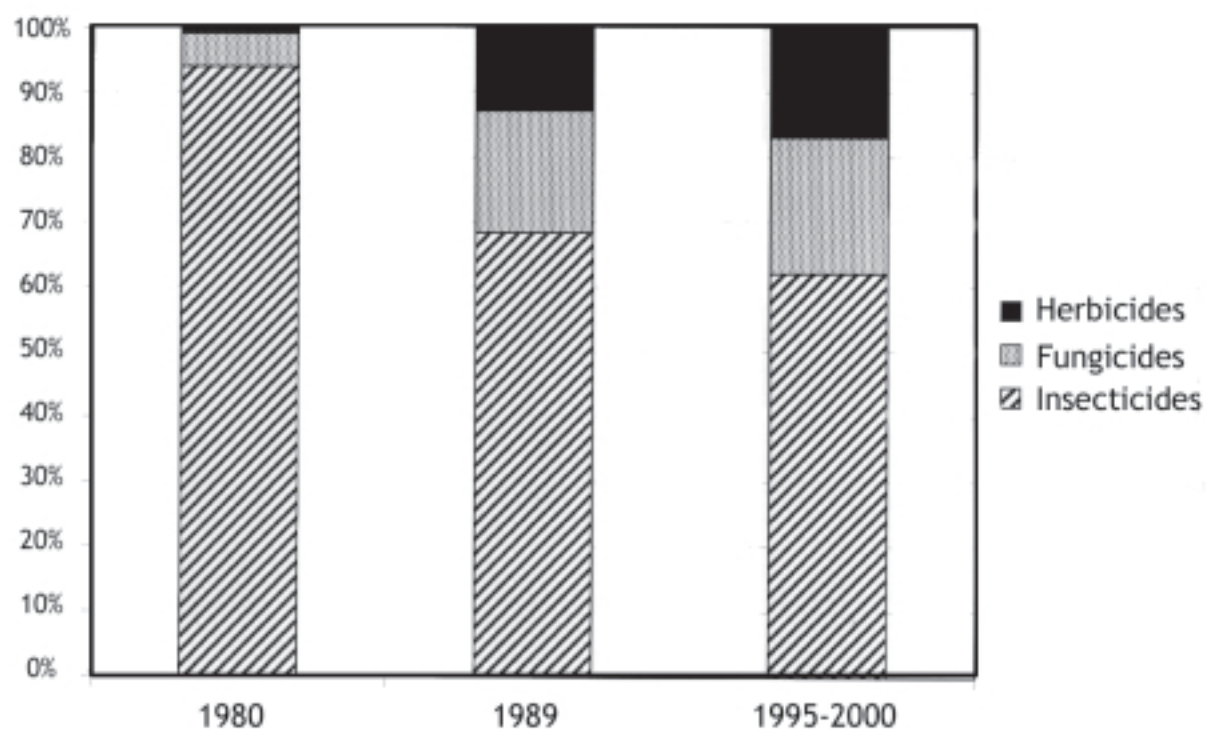
Over time, pesticides tend to create more pest problems than they solve, causing increased crop losses as well as health and environmental damage. While Chinese farmers bear the brunt of illnesses caused by the country's growing reliance on pesticides, the world's consumers are also at risk. The Chinese government has banned some of the worst pesticides, but overall use continues to climb. Efforts to reduce pesticide use or even ensure quality control have been undermined by conflicts of interest inherent in the agricultural extension and pesticide supervision systems. Government agencies have pursued a variety of schemes to promote the production of food with little to no pesticide residues, but this work affects only a small proportion of the total food supply. The Chinese government needs to take bold and decisive steps to free Chinese farmers from the pesticide treadmill and improve the safety of its food.

Potential WTO Implications

China's recent entry into the World Trade Organization (WTO) will pose new challenges and opportunities for food production, food security, and the Chinese family farm. Poor quality, high production costs, and limited processing capacity have put many Chinese agricultural products at a disadvantage compared with imports, which already had risen to \$9.4 billion by 1999 ("China sees influx," 2000). WTO entry is likely to lead to a surge in cheap imports of wheat, maize, and soybeans, which could potentially throw millions of Chinese producers off the land. If domestic food production and rural incomes decline dramatically, however, the Chinese government is expected to increase investment in agricultural research and development to help farmers become more competitive (Huang, Rozelle & Zhang, 2000).

In terms of opportunities, WTO entry also may expand export potential for Chinese horticulture and livestock products, particularly if increased investment allows farmers to improve productivity and food quality. This expectation of exports could have health and

Figure 1. Types of Pesticides Used in China



Source: 1) Xiang R.J. and Kuang R.P. (2001) *Overview of pesticides issues in China*. Unpublished study, Kunming: Yunnan Entomological Society; 2) *Report on the status of the environment in China* (2000). Beijing State Environmental Protection Administration.

environmental benefits, since Chinese farmers face stricter enforcement of standards for maximum pesticide residue levels if they intend to export. In fact, the fear of export market rejection of their produce already is generating interest among some local government leaders in promoting schemes to reduce the use of the most toxic pesticides. For example, in 2001, new European Union (EU) regulations reduced pesticide tolerances for tea by 100 times, effectively excluding half of China's tea exports to the EU. This rejection caused more than \$125 million in losses to farmers in Zhejiang. In response, local officials set up their own organic certification program for tea in order to recapture some of the EU market (Ma, 2001). As Chinese agriculture becomes more integrated into the global economy, China's pesticide residues are coming under greater international scrutiny, with potentially positive implications.

PESTICIDE TRENDS

China's problems with pesticide residues can be better understood by examining recent trends in Chinese

pesticide production and use. China has become one of the world's largest producers and consumers of pesticides. Reliable statistics are difficult to find, but government sources report that pesticide production jumped from an estimated 230,000 tons (of active ingredient) in 1995 to 424,000 tons in 1999, with China exporting 147,000 tons of this total—an increase of more than 35 percent over the previous year (AGROW, 2000a). In 1999 pesticide imports were estimated at 48,000 tons (AGROW, 2000b). Chinese consumption of pesticides averaged 230,000 tons per year during the period 1995 to 2000 (*Report on status*, 2000). China Chemical International Consulting estimates Chinese demand for pesticides will reach 300,000 tons in 2005, and then climb to 350,000 tons in 2015 (AGROW, 2000a).

When China opened the door to foreign investment in its chemicals sector, multinational pesticide companies like AgrEvo, Bayer, DuPont, Mitsubishi, Monsanto, Novartis, Reilly Chemical, Rhone-Poulenc, Rohm and Hass Chemical, Rotam and Zeneca all moved in quickly.¹ These companies all have set up joint ventures and

foreign-owned enterprises in China to take advantage of a relatively cheap and unregulated location for pesticide production. Meanwhile, unauthorized Chinese pesticide companies have taken advantage of lax regulation to dump cheap, frequently counterfeit products onto the domestic market. Struggling to compete with these outlaw firms, China's established pesticide factories continue to churn out legal but highly toxic pesticides.

Pesticide use—which varies widely by region and farming system—is highest in China's wealthy, developed areas on the southeast coast, while poor areas, such as the northwest and southwest, use the least.² However, farmers in grain growing areas in the North China Plain who have been using pesticides for many years are increasing their applications in response to pests developing pesticide resistance. Pesticide use is highest in greenhouses, where the chemicals are applied at up to ten times the rate of application in fields, and often are mixed in lethal cocktails containing up to seven different pesticides (Kamp, 2002).

While consumption of insecticides exceeds that of herbicides and fungicides combined, herbicide use is growing quickly. In 2001, Chinese insecticide use increased by more than 10 percent over the previous year, while fungicide and herbicide use increased by 4.5 percent and 9.4 percent, respectively (Institute for Control of Agrochemicals, Ministry of Agriculture, 2001). (See Figure 1 for pesticide use trends since 1980)

Several factors have contributed to China's heavy reliance on pesticides. One is the government's historical role in promoting Green Revolution technologies and requiring farmers to produce high yields to ensure the country's food security. Although agricultural overproduction in recent years and China's entry into WTO have shifted the emphasis of government's food policy in many crops from quantity to quality, the legacy of pesticide overuse remains. Another factor explaining continued pesticide overuse is the widespread shift in crop type. When Chinese farmers regained some control over what crops they could grow under the economic reforms of the 1980s, many switched from grains to more pesticide-intensive fruits and vegetables and cash crops. Finally, as farm households began to earn more money by selling their produce in the markets and sending family members to work in the cities, substituting labor-saving herbicides and insecticides for hand-weeding and manual control of insects became a necessary and viable option.

DETRIMENTAL IMPACTS OF PESTICIDES

Chemical Dependency

Like addictive drugs, pesticides can create initial

benefits for the users. Pesticide sales agents and agricultural extension agents—who frequently have a personal financial stake in increasing sales—convince farmers to use ever more powerful and environmentally destructive chemicals to avoid crop losses. The result is a vicious cycle, with the toxic chemicals further eroding the farm ecosystem's natural resistance to pests and diseases. In the long run, pesticide dependence leads to increased crop losses, as well as health and environmental damage.

Many Chinese farmers abuse pesticides because agricultural extension agents have convinced them to abandon the traditional farming practices and have not taught ecological principles to guide the farmer's pest management. Most farmers know little about protecting the natural enemies of pests, such as predators and parasites. As a result, they often spray broad-spectrum pesticides, a practice that leads to secondary infestations of the original pest, because pests usually recover faster than their natural enemies. Broad-spectrum pesticide use also causes infestations of new pests that were previously kept in check by beneficial insects.

In the field, Chinese farmers often double or triple the dose of pesticides recommended by experts, either because they overestimate the potential crop losses (Huang et al., 2000) or because they believe the pesticides they are using may be fake (Hu et al., 1998). High levels of pesticide use inevitably cause pesticide resistance, as the stronger insects survive the spraying and give rise to the next generation of resistant pests, which can only be killed with even more toxic pesticides, if at all. By the late 1990s, many Chinese farmers already had reached the point of diminishing returns and were looking for ways to escape the pesticide treadmill. However, most of them lacked information about adverse effects of pesticides and alternative means of pest management.

Cotton farmers in the northwestern region of Xinjiang have paid the price of pesticide use and the resulting loss of natural enemies. In 2001 aphids and red spider mites attacked over one million hectares of cotton fields in the region. While drought and cold air coming from Siberia made the situation worse, the major cause of the severe pest outbreak was the use of highly toxic pesticides that killed beneficial insects ("China's biggest cotton zone," 2001). A local official in Shihezi City expected crop losses to climb to \$85 million that year. See Box 1 for a case study of Hongxin Village illustrating more of the pitfalls of pesticide use in China.

Threats to Human and Ecological Health

Pesticide use also threatens human health in China. Experts estimate that 70 percent of pesticides used in

Box 1. A Survey of Hongxin Village—Ecological and Health Problems of Pesticide Use

In the mountainous Sichuan Province, two nongovernmental organizations—Center for Community Development Studies and the U.S.-based Pesticide Action Network North America (PANNA)—conducted a case study in Hongxin Village that illustrates the many problems of pesticide use in China (Lu and Hamburger, forthcoming). According to a survey of one hundred households taken in July 2001, pesticide and chemical fertilizer use in Hongxin increased rapidly and steadily between 1980 and 2000. Farmers in this small village began growing vegetables for sale on the free market in 1989. Initially, a market-oriented, chemical-dependent farming approach brought increased yields and profits. Farmers estimated that average annual incomes rose from 40 to 2000 Yuan between 1980 and 1990, while yearly pesticide costs rose from 10 to 100 Yuan per year during the same period. However, the pesticides also killed beneficial insects and farmers found themselves facing increasing numbers of pests that had previously been kept in check by predators and parasites. Particularly devastating was an infestation of a new vegetable pest, the leaf miner, which quickly became resistant to pesticides, forcing the farmers to switch to less profitable crops. Average farmer household income thus fell from a high of 4000 Yuan in 1995 to 800 Yuan in 2000, while pesticide expenses surged from five to fifty percent of farmers' income over the same period. Since ecological disruption and pesticide resistance had become severe, farmers in Hongxin taking the survey expressed interest in learning about ways to reduce pesticide use, but they had never received any training in alternative pest control methods.

The survey and study in Hongxin Village also revealed that many farmers had switched from highly toxic to less toxic pesticides over the last twenty years, but the use of highly toxic pesticides still was widespread. About 30 percent of the pesticides farmers in Hongxin were using at the time of the study fell within the "extremely or highly hazardous" classification as set by the World Health Organization. Yet, the farmers had a limited knowledge of how to reduce their exposure through the proper storage, handling, use, and disposal of pesticides. Although most farmers took at least one precaution—such as wearing gloves or a mask, tying a sheet of plastic around their waist while spraying, or washing their hands after spraying—these measures were minimally effective, as evidenced by the fact that many farmers had experienced skin irritation and dizziness after applying pesticides. Villagers reported that one man in the village had suffered from acute poisoning. In addition, easy access to these highly toxic materials had enabled six people in the village to use pesticides to commit suicide.

China are "highly toxic," accordingly to the Chinese government's classification system. Health effects are magnified when pesticides are used in ways that increase exposure, most notably when they are mixed by hand, applied using sprayers that allow pesticides to come into contact with the farmer's skin, or sprayed into the wind so they are inhaled. As is typical in most developing countries, most Chinese farmers lack protective clothing and equipment for pesticide application, because they are considered either too costly or uncomfortable to use during hot summers. Improper storage, handling, and disposal of pesticides not only contribute to direct exposure but also can lead to indirect exposure through contamination of drinking water and fish. Finally, the consumption of food containing high levels of residues can have immediate as well as long-term adverse affects on human health, particularly the health of children.

A small number of case studies provide some anecdotal evidence of the occupational health problems

related to pesticides. In one case study that documented the health effects of pesticides, rice farmers in Zhejiang Province were interviewed and examined by a medical team (Huang et al., 2000). The tests measured levels of chemicals in the body that are known indicators of pesticide poisoning affecting various organs. The tests indicated pesticide poisoning of the liver, kidney and nerves in 22%, 23%, and 6% of farmers, respectively. There was a close relationship between pesticide use level and the level of liver function abnormality. Many of the farmers also had abnormalities in their blood. While eye problems, headaches, as well as skin effects and respiratory irritation from pesticides also were reported, farmers did not consider these problems important enough to see a doctor or take time off from work.

Aside from a small number of case studies, the health effects of China's excessive pesticide use are largely undocumented and existing reports contain widely varying estimates of annual poisonings and deaths. A

study published in 2000 reported that pesticide poisoning affected from 53,300 to more than 123,000 persons each year in China in the previous decade (Huang et al., 2000). The same study attributes about half of the poisonings to pesticide use in crop production. Moreover, in a “normal” year, about 300 to 500 Chinese farmers die due to improper use and overuse of pesticides in crop production. However, experts in Yunnan Province believe that this number is an underestimate, since over 100 farmers are killed each year by pesticide poisoning in Yunnan alone (Zhong, 2001). Another report estimates that pesticides accidentally kill approximately 10,000 people annually (Li et al., 1997). The statistics are complicated by the fact that many farmers, especially women, commit suicide by drinking pesticides. Chinese death statistics indicate that 250,000 people committed suicide each year during the 1990s, and drinking pesticide was the most common method (“Suicide by pesticide,” 2001).

Pesticide residues in food also result in poisonings, but the number of Chinese consumers poisoned by pesticide residues is unknown. The National Product Quality Supervision, Detection and Quarantine Bureau summarized the results of tests of 181 vegetable samples from 23 Chinese cities and found that 47.5 percent of the samples exceeded the allowable levels of pesticide residues (*China Youth Daily*, 2001). Chronic effects of pesticides on the health of consumers are suspected, but little research has been done in this area.

Reliable statistics on the ecological effects of pesticide use in China are even harder to find. Pesticides, along with industrial pollution, have severely contaminated rivers and lakes, and threaten China’s remaining biodiversity. In addition to toxic agricultural runoff, accidents also contaminate the environment—for example, a single boat accidentally dumped 50 tons of the pesticide methamidophos into Yangtze River on 19 June 2000 (Wu, 2000). Throughout China many farmers report having seen rivers once teeming with fish become barren over the last decade, while many economically valuable species of lake fish have become extinct (Becker, 2001).

CHINESE PESTICIDE LAWS, REGULATIONS, AND POLICIES

The Chinese government has an uneven record in regulating pesticides. Although it has banned some of the worst pesticides, overall use continues to climb. Efforts to reduce pesticide use or even ensure quality control have been undermined by conflicts of interest inherent in the agricultural extension and pesticide supervision systems. Attempts to ensure that qualified agents sell pesticides and to prevent the sale of food with excessive pesticide

residue have been largely ineffective.

Pesticide Laws

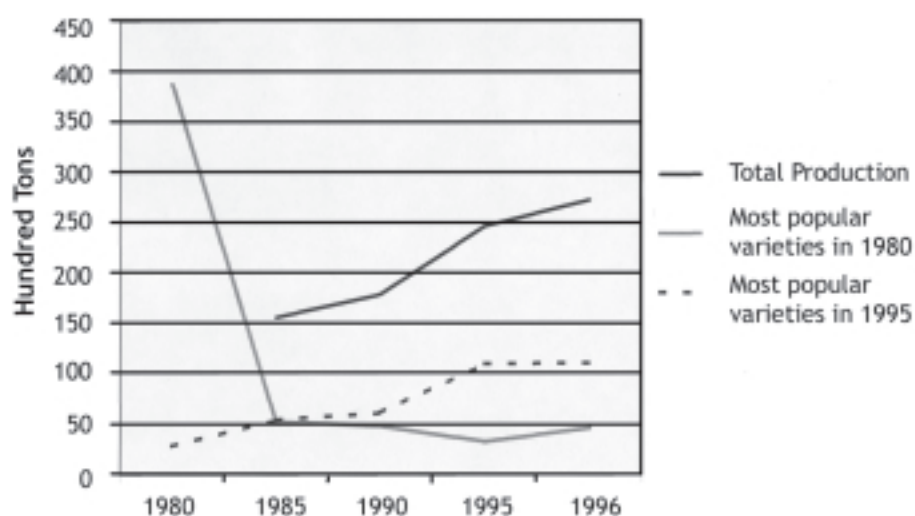
In the early 1980s, Chinese government officials became concerned about the high toxicity and high residue levels of pesticides used on crops and therefore formulated several policies and regulations on pesticide manufacture and use. The Ministry of Agriculture and Ministry of Public Health issued the Pesticide Use Safety Rule in June 1982. This rule classified pesticides into three types: high, moderate, and low toxicity. In order to protect public health, highly toxic pesticides were strictly banned for use on fruits, vegetables, and grain crops. In addition to national regulations, most provinces and some counties declared similar rules to ban the use of highly toxic pesticides on agricultural crops. The central government also banned the production of extremely hazardous organochlorine and organophosphate pesticides in 1983 and mandated the phase out of the highly toxic insecticide lindane in 1984 (Huang et al., 2000). DDT production was curtailed in 1983 and its use was limited to nonagricultural purposes, such as mosquito control. As of 2001, no products containing DDT were registered for use in China. However, in cases where highly toxic pesticides were banned for use on certain crops but the products themselves were not banned, it is still relatively easy for farmers to obtain and use them. In addition, banned and counterfeit pesticides continue to spread via the black market. In order to understand the impact of these bans on pesticide use, Box 2 illustrates the overall increase in pesticide (insecticides, fungicides, herbicides) production alongside the trends of the most commonly used pesticides in 1980 and 1995.³

The Pesticide Management Regulation of China, which became effective in 1997, addresses pesticide manufacture, use, and environmental impacts. Most provinces also have declared similar local regulations. Under these regulations, chemical and pesticide production is controlled by a licensing system. Manufacturers must obtain a production license from the Ministry of Chemical Industry and register at a provincial Institute for Control of Agrochemicals, and at the Technical Inspection Bureau. The National Institute for Control of Agrochemicals of the Ministry of Agriculture (ICAMA) oversees registration and quality control of pesticides. Pesticide management stations are charged with carrying out inspections at the county level, but not every county has established such a station yet (Hu et al., 1998). ICAMA has been working with experts from the German development agency GTZ on promoting quality control of pesticides and updating pesticide legislation at the local

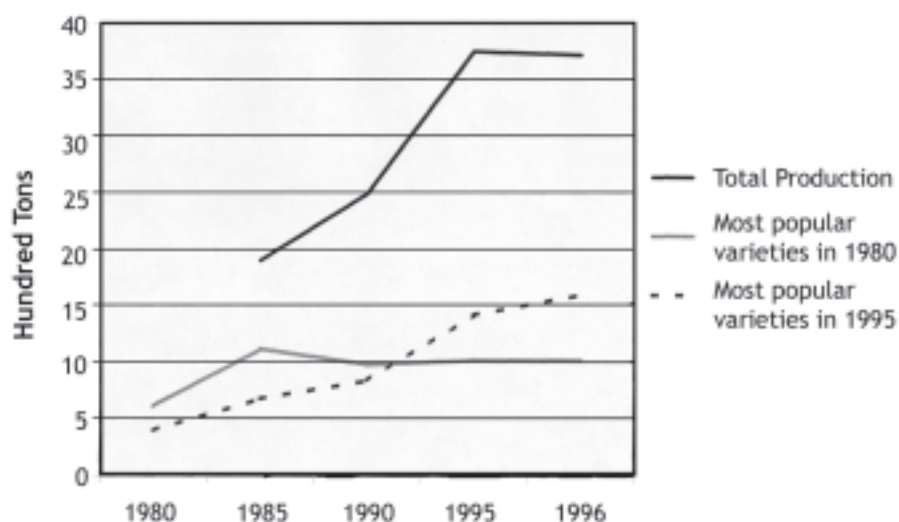
Box 2. Pesticide Production Trends in China

Bans on persistent organochlorine pesticides and some extremely hazardous organophosphate pesticides in the early 1980s resulted in a dramatic decline in insecticide production between 1980 and 1985. Although insecticide production began to climb again between 1985 and 1996, the organochlorine pesticides DDT and lindane were gradually replaced by less persistent (but still highly toxic) alternatives. For example, methamidophos, one of the top three insecticides produced in 1995, is a potent nerve toxin that can cause muscle paralysis, among other symptoms (EXTOXNET, 2002). Fungicide use nearly doubled and herbicide use more than quadrupled between 1985 and 1996. The graphs illustrate the overall increase in pesticide (insecticides, fungicides, herbicides) production alongside the trends of the most commonly used pesticides in 1980 and 1995 (see footnote 3 for specific names of these top pesticides).

**Insecticide Production for Selected Major Varieties
1980-1996**

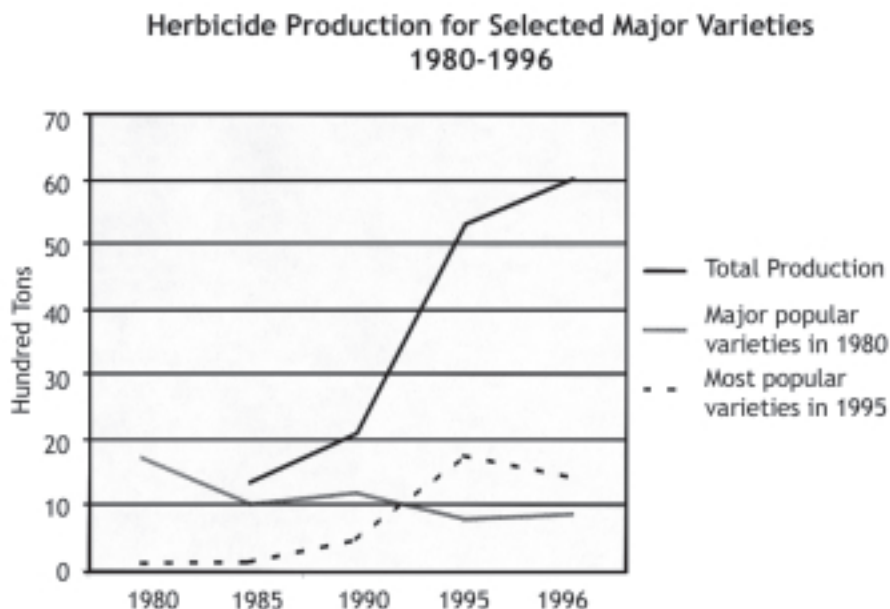


**Fungicide Production for Selected Major Varieties
1980-1996**



(continued on page 36)

(continued from page 35)



Source: Data for these graphs were drawn from various issues of the Ministry of Chemical Industry's *Chemical Industry Yearbook of China* cited in Huang et al., 2000.

level.

Regulations require that before a pesticide plant is set up, the provincial Environment Protection Bureau also must carry out an environmental impact assessment. A survey conducted in Hubei and Zhejiang provinces revealed that many factories, especially older ones, had not conducted the required environmental assessments (Hu et al., 1998). In addition, the older pesticide factories, which are often state-owned but no longer receiving government subsidies, often lack the funds to make the transition to producing less toxic pesticides and the government provides no incentives for them to do so (Hu et al., 1998). Pesticide producers actually face a financial disincentive to switch to new less toxic pesticides because if they do, they must pay patent fees (Meng, 2001).

The government also tries to regulate pesticide at the point of sale by requiring pesticide shops to meet certain qualifications. For example, they need: (1) a general trading license from the Industry, Commercial, and Administration Bureau; (2) a pesticide marketing certificate from the pesticide management station; and (3) a qualification certificate from the pesticide management station. Few shops have the latter two types of certificates, and many village-level shops are run by staff with no special training in pesticide use (Hu et al., 1998). These shops also are required to provide sufficient

space for the safe storage of pesticides, but few shop managers are aware of these regulations (Hu et al., 1998).

Conflicts of Interest

Cutbacks in government funding for provincial and sub-provincial agencies have pressured government officials to raise money for their offices and salaries through alternate means. For example, agricultural extension agents generate most of their funds for offices and salaries through pesticides sales. While most of these officials are more qualified to sell pesticides than untrained shopkeepers in the villages, the system of drawing salaries from pesticide sales raises conflict of interest problems. For example, provincial Institutes for Control of Agrochemicals now are involved in marketing as well as inspecting pesticides (Hu et al., 1998). Similarly contradictory duties exist within county plant protection stations that are responsible for both selling pesticides and promoting ecologically based pest management. Agricultural extension agents, who work at these stations, have been encouraged to raise money through entrepreneurial activities such as selling pesticides.

The lack of comprehensive monitoring of pesticide residues on agricultural products, as well as weak enforcement of such regulations, mean there are no credible incentives for farmers and government grain

sellers to control pesticide residues. The Chinese government has established maximum residue levels for pesticides in food but, as mentioned above, these standards are regularly violated.

Two important steps toward reducing pesticide residues are to investigate the extent of the problem and publicize the information. Pesticide residues are normally measured using gas chromatography or high pressure liquid chromatography, which can cost from \$60 to \$180 per sample depending on the number of pesticides measured. A joint ICAMA and GTZ project has introduced a cheaper method called enzymatic fast detection, which costs less than one dollar per sample. Although this method can only detect common, highly toxic pesticides, such as organophosphates and carbamates, and is less sensitive, it is still useful for gathering some data on pesticide residues and raising awareness of the problem. Based on the positive experience of using the equipment in six pilot provinces, the Ministry of Agriculture bought 100 machines for use throughout China (Betz, 2002). Discussion of pesticide residues among the general public and in the press has increased greatly over the past three years, a good sign that consumer pressure for cleaner food is building. In fact, some of the larger markets in big cities like Beijing are starting to check food products for pesticide residues. However, even if these markets reject the products, it is likely that these agricultural products will be sold elsewhere rather than be destroyed or returned to their place of origin. Much greater accountability will have to be built into the food chain before farmers get a clear message that they will not be able to sell their food if pesticide residues contaminate it.

As in many areas of Chinese environmental management, pesticide laws and regulations are reasonably strong and thorough, but implementation is weak. The Chinese government will need to put more political muscle into reforming and strengthening systems and institutions and devote much greater financial and technical resources into enforcement if it intends to make real progress in controlling the production, sale, and use of high toxicity and high residue pesticides.

PROMOTION OF CLEAN FOOD PRODUCTION IN CHINA

The Chinese government has supplemented its efforts to control pesticide supply with attempts to reduce demand by promoting alternative farming methods and systems. The Ministry of Agriculture (MOA), the State Environmental Protection Administration (SEPA), and other government agencies have pursued a variety of marketing, technology transfer, and incentive schemes to

promote the production of food with little to no pesticide residues. Some of this work has received technical and/or financial support from international organizations. Government agencies also have allowed and in some cases supported the work of Chinese and international nongovernmental groups that promote sustainable agriculture.

Green Food

MOA created the green food label in 1990. Leaders of MOA's Department of State Farms developed green food as a niche for food grown under strictly controlled chemical use (Thiers, 2000). The goal was to take advantage of the state farms' centralized control of production practices and relative isolation from industrial pollution sources to produce cleaner food.

The Green Food Development Center was set up to develop standards, certification, and administration for the label. With support from MOA and the State Council, green food development offices spread to many cities and counties in almost every province of China. Under this green food label initiative the China National Green Food Corporation was granted the right to export products directly instead of going through the foreign trade ministry (Thiers, 2000). Responding to the incentive of price premiums associated with exports, non-state farms began seeking to obtain the green food label. By the end of 1999, China had labeled 1,360 products from 742 enterprises as green food, with sales of \$3.7 billion (Yunnan Entomological Society, 2002).

The Chinese green food system now has two levels: Grade A for food with pesticide residues that do not exceed allowable levels,⁴ and Grade AA, which has become more similar to international organic standards over time, but still is not widely accepted abroad (Thiers, 2000). Acceptance of Grade AA green food as organic has been slow, mainly because of the lack of third party monitoring, which is required by recognized bodies such as the International Federation of Organic Agriculture Movements. Even the Grade A green food has a credibility problem within China, as there is no evidence that production practices or products are monitored regularly. Comparative research of over 1,000 products of the Green Food Development Center showed that the producers have problems guaranteeing low levels of pesticide residues, but the program is reducing pesticide use to some degree (Wu, 1999).

Organic Food

Export companies are largely responsible for developing approximately 200 Chinese organic products.

Most of these organic products are exported to Japan, Europe, and the United States, though some are sold in China's big cities, where specialized supermarkets now stock everything from organic soy sauce to lychees (Gilley, 2001).

Last year, the Chinese Organic Food Development Center (OFDC), which is affiliated with SEPA, began certifying farms based on the standards of the International Federation of Organic Agriculture Movements. OFDC products have met with some resistance in foreign markets because OFDC is not accredited according to the standards of the International Organization for Standardization (ISO Guide 65) and China does not yet have a national organic regulation. Some Chinese growers have sought to improve their access to foreign markets by working with internationally recognized organic certifiers, such as Organic Crop Improvement Association, Ecocert, and the German certifier BCS.

China's poor farmers in remote regions who could never afford to use pesticides in the first place may be in the best position to meet the country's growing demand for organic food. Their soils are usually uncontaminated by industrial and agrochemical pollution and these farmers often retain knowledge of traditional farming methods (such as crop rotation and intercropping) that naturally increase soil fertility and reduce pest infestations. The relatively clean soils of poor regions in western China may prove to be fertile ground for organic production, as China pursues a policy to "Develop the West." (*Editor's Note: See article by Elizabeth Economy in this volume for more information on the Develop the West campaign*)

On the other hand, poor farmers face the challenge of transporting their products from the remote areas where they live to urban markets where wealthy consumers will buy them. Also, poor farmers may not have the resources to undertake the intensive soil fertility management that organic farming requires. Therefore, farmers living closer to urban areas with ready access to markets and technical support may be even better placed to pursue organic farming, as long as their soils are not heavily contaminated. In addition, well-known production areas in highly developed regions in eastern China may choose to go organic to improve their reputations. For example, Guangdong—which has the highest per acre pesticide application of any province in China—has explicitly embraced the development of the organic farming sector in its new provincial agriculture plan.

As organic demand grows, so will the incentive for conversion from chemical-dependent Green Revolution techniques back to ecologically based farming systems.

Organic conversion will be difficult because most communities have lost their traditional agricultural knowledge, and China has few experts or technical staff who can train farmers in organic agricultural practices. Nevertheless, some pioneers are forging ahead. For example, the Nanjing-based Organic Farming Development Project, which cooperates with experts from agricultural universities and local government, began re-introducing techniques such as intercropping, biological pest control, and green manure to farmers in Yuexi, Anhui Province in 1998 (Pennarz, 2000). Three years later, farmers from one of the villages in Yuexi organized China's first association of organic kiwi growers to provide technical support and jointly market their products. They have developed their own requirements and internal documentation system, and farmers who participated in the project since its inception have now received organic certification.

Integrated Pest Management

Even for farmers who do not go organic, economic and environmental gains from reduced pesticide use are well within reach. Studies of Chinese farmers who received training in ecologically based integrated pest management (IPM), have shown that these farmers developed an understanding of the rice ecosystem, and were able to use their knowledge to maintain yields and increase profits while reducing their use of pesticides (Mangan & Mangan, 1998).

China has received technical and financial support for IPM activities from the UN Food and Agriculture Organization (FAO) since 1988 (Kamp, 1999). At the national level this IPM program has been implemented through the MOA's Plant Protection Division of the National Agro-Technical Extension and Service Center. The Plant Protection Station of each Provincial Agriculture Bureau implements the program at the provincial level. While ten provinces were involved in the earlier phases of the program, six southern provinces are being supported in IPM activities as of 2001: Sichuan, Guangdong, Anhui, Zhejiang, Hunan, and Hubei. The participatory IPM programs in Sichuan Province have been particularly successful. (See Box 3)

NEW TECHNOLOGY AND INNOVATIVE PRACTICES

Sometimes simple changes in farming practices can enable farmers to drastically increase yields without using chemicals. For example, researchers in Yunnan Province found that intercropping sticky rice with standard rice varieties dramatically decreased the incidence of the fungal disease rice blast, allowing farmers to stop using fungicide

within two years. The authors of a study published in the journal *Nature* reported that blast severity on sticky rice averaged 20 percent in pure stands, or monocultures, but was reduced to 1 percent when sticky rice was dispersed in fields of standard rice in 1998, the first year of the experiment (Zhu et al., 2000). Evidently, planting a mixture of varieties reduces disease because plants susceptible to the disease are physically separated from each other. Highly susceptible sticky rice plants were planted in rows with several rows of disease-resistant standard rice in between. The standard rice serves as a barrier to the wind-blown fungal spores. The ongoing experiment covers 100,000 acres and involves tens of thousands of farmers in China.

In a similar success story, researchers helped poor farmers in Shandong and Anhui provinces increase sweet potato yields as much as 30 to 40 percent without additional fertilizers, pesticides, or genetic improvements. The crops are produced by extracting tiny bits of disease-free plant material from infected plants and re-growing them under sterile conditions. The resulting virus-free plants are then regenerated in greenhouses where they form small roots used to grow virus-free vine cuttings. Using this method, farmers in Shandong and Anhui provinces currently are growing about 30 million tons of virus-free sweet potatoes annually on 800,000 hectares (1.97 million acres). About 80 percent of the sweet potatoes grown in the two provinces are now derived from virus-free planting materials. The harvests from these 800,000 hectares capped a five-year growth period that added more than \$550 million to China's farm economy (Fuglie et al., 1999).

Eco-Counties and Demonstration Areas

Beginning in the 1980s, MOA set up one hundred Eco-Counties (*shengtai xian*) across the country to encourage integrated agriculture, forestry, energy use and environmental protection in rural areas ("Eco-environmental protection," 2001). Developing green food can be an important step toward achieving sustainable development goals in these counties, which sometimes have greater access to training and other resources.

SEPA has a similar kind of program to promote ecological agriculture or environmentally friendly industry in 111 counties or county-level cities through its Eco Demonstration Area (EDA) program. While SEPA has traditionally focused on promoting cleaner production in urban industries, its mission expanded to include agriculture in 1998. The Ecological and Rural Environment Division of SEPA's Department of Nature Conservation is now responsible for promoting

sustainable agriculture. Although the United Nations Environment Programme has recognized this EDA program for its environmental achievements (Hu, 1999), opportunities for scaling up the program are limited by the availability of subsidies.

Education and Advocacy Groups

A few Chinese nongovernmental organizations (NGOs) and research groups have begun conducting sustainable agriculture education and advocacy work, often with assistance from Chinese government or international supporters. For example, Rural Women Knowing All is a nonprofit group providing women farmers with training in the use of pesticides made from plants. The group is affiliated with the All-China Women's Federation and has received project support from the Ford Foundation.

Another important education and advocacy group is the Yunnan Entomological Society (YES), which has evolved from an academic exchange organization into an active promoter of pesticide reduction, biological control, and organic farming. YES, along with many NGO and government partners, is encouraging the Yunnan Provincial government to develop organic agriculture. YES also has set up a Web site containing pesticide information in Chinese and English and is conducting consumer outreach activities among student groups and women's organizations. Members of YES in early 2002 registered a new organization called the Pesticide Eco-Alternatives Center (PEAC). PEAC founders will recruit staff, volunteers, partners, and advisors from a broad range of organizations, including YES, student environmental groups, government agencies, consumer unions, women's federations, and hospitals. PEAC also will collaborate with Pesticide Action Networks of North America (PANNA) and Pesticide Action Network Asia-Pacific region. (*Editor's Note: See the NGO inventory in this issue of the China Environment Series for specific project descriptions*) YES has begun to establish a reputation for supplying hard-to-find information, such as pesticide residue standards in China and abroad and organic farming techniques. A few members of YES have formed a new group called Green Mountain Women that conducted educational outreach in 2002 to women on the need to protect their family's health by buying organic and green food. YES has received support from Global Greengrants Fund and Rockefeller Brothers Fund, and Green Mountain Women has received a grant from Global Fund for Women.

Two Hong Kong nongovernmental groups—Produce Green and Greenpeace—also are promoting sustainable agriculture in China. Produce Green is a small organic

Box 3. Farmer Field Schools—Creating Participatory IPM in Sichuan Province

The Sichuan Agriculture Department's Provincial Plant Protection Station has been promoting participatory integrated pest management (IPM) since 1989. The establishment of IPM in Sichuan is especially important because the large, fertile Sichuan Basin produces much of China's grain. IPM activities primarily have focused on rice, although a new project for oranges is now underway. Additionally, farmers and officials in the province are interested in developing IPM methods for vegetables. The Sichuan government's decision to provide political and financial support to the IPM effort has been a key to its success.

UN Food and Agriculture Organization (FAO) experts consider Sichuan's IPM program to be one of the best in China. The program utilizes the "farmer field school" approach, an innovative participatory learning process through which villagers apply critical thinking skills to agro-ecosystem analysis. Farmer field schools involve weekly meetings by a group of farmers. Instead of just listening to lectures and learning from textbooks, the farmers analyze the ecosystems in their rice fields and conduct experiments on pest-predator relationships and other farm-related issues. Research has shown that farmers exposed to this ecology-based paradigm of IPM learn and retain more than those who learn to base pesticide application decisions on economic thresholds (Mangan et al., 1998). While farmers trained in farmer field schools apply less pesticide to their crops, they experience no significant differences in yields compared with their counterparts trained in the economic threshold approach.

Graduates of a three-year IPM course in the Sichuan township of Tumen formed a community group to continue teaching farmers in their village about ecological pest management. They said that before the course, they had used highly toxic pesticides that caused health and ecological problems. Every year, two or three people would have to go to the hospital to be treated for pesticide poisoning. Several pigs died after eating fodder contaminated with pesticides. Moreover, the fish and frogs living in the rice paddies and irrigation ditches all died and bird populations declined. Now that the farmers have switched to less toxic pest management methods, no more poisoning incidents have been reported and frog and bird populations are on the rise.

Women farmers are a key target for IPM training courses, for they now comprise 70 percent of China's agricultural labor force because men have been leaving the countryside for jobs in urban areas. PANNA and the Center for Community Development Studies visited a farmer field school in Xinshi Township (Sichuan) where 25 women had learned how to identify pests and natural enemies and how to manage insect populations using *Bacillus thuringiensis* (Bt), a beneficial organism used in organic farming. After the course was over, the village agricultural technician tried to sell the people in the village a highly toxic insecticide. The women who had participated in the training course not only refused to buy it, but also convinced everyone in their village to switch to Bt instead. The programs in both Xinshi and Tumen townships show the potential for participatory IPM to empower farmers to achieve impressive reductions in the toxicity and frequency of pesticide use.

farm that teaches schoolchildren about how healthy food is grown. Greenpeace Hong Kong is leading a fight against the potential bio-piracy of Chinese soybeans as part of Greenpeace's international campaign against the use of genetically engineered crops.

POLICY OPTIONS

The Chinese government needs to take bold and decisive steps to control pesticide use, both to protect the health of its people and to safeguard the reputation of its growing agricultural exports. International pressure for public health and environmental protection, as well as global and domestic consumer demand for safer food are beginning to be reflected in government policy, but more intensive efforts are needed to free Chinese farmers from the pesticide treadmill. Some options include:

1. Strengthen and enforce regulations on pesticide production and use.

The Chinese government needs to consolidate authority for controlling pesticide production in one agency. China also needs stronger penalties for companies producing or selling pesticides that are not registered or have been banned. Current efforts to improve quality control of pesticides need to be continued and expanded. Local efforts to reduce sales of banned pesticides by fining local shops and closing down repeat offenders should be encouraged. Finally, turning poisonings resulting from violations of pesticide regulations into criminal offenses may help prevent unnecessary deaths in the future.⁵

2. Increase provincial support for sustainable agriculture programs and national policies, including integrated pest management, green food, and organic food.

Provincial governments should provide farmers with alternatives to pesticides by strengthening technical assistance in integrated pesticide management (IPM) and biological control. A prerequisite for any serious efforts to train plant protection staff and agricultural extensionists in promoting ecologically based IPM is to remove the conflict of interest inherent in allowing extensionists to profit from pesticide sales. This means more funds will be needed for government extension staff salaries. While the government may not be able to finance all agricultural extension functions, these responsibilities should not be handed over to multinational corporations, which are unaccountable to local governments. Other financing options for providing these services that have been developed in other countries need to be researched and adapted to conditions in China.

3. Fully fund pesticide residue monitoring programs for all food and raise farmer and consumer awareness of pesticide risks.

The government should continue and expand monitoring of pesticide residues and use the results to raise consumer awareness of health risks and create demand for clean food. Partnerships with consumer unions, women's federations, and schools can help the government spread information to both farmers and consumers about the effects of pesticides on the environment and people, as well as the need to eliminate unsafe pesticide practices and purchase healthy food.

4. Improve systems for monitoring food production to build consumer confidence in food labeled as safe.

Since analysis of pesticide residues as a guarantee of product integrity is too expensive, China needs to build up a reliable third party monitoring system for clean food production, such as international organic farming standards. While strengthening independent certification of crops would be challenging, such a move would help build consumer confidence in organic and other food labels.

5. Increase government funding for research on non-chemical pest management and prohibit government researchers from accepting research funds from pesticide companies.

The Chinese government needs to continue to invest in research on ecologically based, non-chemical solutions to pest problems. Public researchers should not be forced

to cover their salaries by conducting research on pesticides with the support of private companies (a common problem in the United States as well). In addition, the government should ensure that the results of research and field trials undertaken at university and government institutes are made available to farmers. The programs meriting support are those that empower farmers and use the results of professional research as the basis of their own field trials.

6. Authorize the Ministry of Health to monitor pesticide poisoning and document the scope of the problem.

The government should authorize the Department of Occupational Health in the Ministry of Health to conduct research on the extent and severity of pesticide poisoning among farmers. Doctors and other health workers need to be trained to recognize the symptoms of pesticide poisoning.

7. The World Bank, Asian Development Bank, and other major donors should ensure their programs support sustainable agriculture and not pesticide company interests.

Multinational lending organizations such as the World Bank can work with experienced technical assistance providers (e.g., FAO and The Field Alliance⁶) to help the government extend IPM to poor regions of China where pesticide dependency is just beginning to take hold. IPM research and training also will be needed in wealthier regions where multilateral development projects are helping farmers grow new crops that are vulnerable to pests and diseases. Given the commitment to reducing reliance on pesticides embodied in its operational policy on pest management, the World Bank is in a good position to become a leading advocate of IPM in China. However, the World Bank's commitment to promoting IPM may be compromised by its growing closeness with multinational pesticide companies and its advocacy of shifting responsibility for agricultural extension from the public to the private sector. Experience in other parts of the developing world has shown that partnerships with pesticide companies, even when the companies volunteer to promote "safe use" of pesticides, usually leads to relatively high levels of pesticide use.

8. The U.S. government could promote more scientific exchanges and joint research projects.

The U.S. government could help support the adoption of alternatives to pesticides in China by sponsoring more scientific exchanges and joint research projects. U.S. scientists also have much to learn from their

Chinese colleagues in this area, and greater collaboration could help both countries make more rapid progress in identifying biological and other non-chemical means of managing pests.

CONCLUSION

The Chinese government needs to work harder and faster to halt the production and use of pesticides that endanger human health and the environment. The Chinese government should take great care in its selection of partners for promoting sustainable agriculture and eliminate any conflict of interest that may interfere with the objective to reduce reliance on pesticides. International NGOs and foundations, the World Bank and U.N. organizations, as well as the United States and other foreign governments can help by: (1) financing training in integrated pest management; (2) supporting NGOs that are building consumer demand for safe food; and (3) facilitating the development of a reliable monitoring system for organic food production. These and many other approaches discussed earlier in this paper can all contribute to helping China kick the pesticide habit.

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ENDNOTES

¹ In the past two years, Astra and Zeneca merged to form AstraZeneca, which joined Novartis to become Syngenta. AgrEvo merged with Rhone-Poulenc to become Aventis.

² Pesticide use is greater than 7 kilograms per hectare in Zhejiang, Shanghai, Fujian, and Guangdong. Pesticide use is less than 0.6 kilograms per hectare in Gansu, Xinjiang, Heilongjiang, and Inner Mongolia (Cai, 1999).

³ *Top 4 insecticides in 1980*: 666 (Lindane), Didiwei (Dichlorvos), Leguo (Dimethoate), and DDT; *Top 3 insecticides 1995*: Jiaanlin (Methamidophos), Shachongshuang (Dimthypo), and Jiaji1605 (Parathionmethyl); *Top 3 fungicides in 1980*: Duojunling (Carbendazim), Jinggangmeisu (Validamycin A), and Yidaowenjing (MAFA); *Top 3 fungicides in 1995*: Duojunling (Carbendazim), Daishenmengxin (Mancozeb), and Yidaowenjing (MAFA); *Top 3 herbicides in 1980*: Wulufenna (Pentachlorophenol (PCP)), Chucaomi (Nitrofen), and 2,4-D; *Top 3 herbicides in 1995*: Dingcaoan (Butachlor), Yicaoan (Acetochlor), and 2,4-D

⁴ The Ministry of Agriculture's Pesticide Use Rule for Green Food sets allowable levels for pesticide residues in these products.

⁵ A recent case in which a man received a jail sentence after his use of a pesticide resulted in a child's death appears to be the first case in which an action resulting in pesticide poisoning has been punished as a crime (*Yunnan Information Daily*, 2001).

⁶ The Field Alliance, a new organization in the region, has been initiated by FAO to replace the Intercountry Programme for IPM in Asia, staffed by former FAO or FAO-trained staff.