CHINESE AGRICULTURE ACHIEVEMENTS, CHALLENGES AND PROSPECTS

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1. Introduction

In October 2004 the Globe and Mail produced a supplement devoted almost entirely to China. The banner face page in Chinese characters, translated as - "ambitious powerful, restless, get ready for China's century". The underlying caption read – *"If you can't read these words, better start brushing up. A profound global shift has begun, the kind that occurs once every few lifetimes. Don't be left behind"*. The following month (Nov. 8-21) Canadian Business magazine, also printed an edition focusing almost entirely on business prospects in China. Both publications emphasized China's unprecedented economic growth and the resulting opportunities. They also touched on significant downsides. Marcus Gee and Geoffrey York in the Globe wrote about the acute environmental problems and the growing wealth divide. Andrew Wahl, in Canadian Business, wrote on the serious and growing water problem. These reinforce the significant concern that we should all have about the frailties of the Chinese economic miracle.

Special editions such as these and the frequency of other articles on China attest to the worldwide interest in China's growing economic and political influence. We don't, however, need to depend on the media to awaken us to the inexorable rise of the Chinese economy: the number of Chinese goods we purchase, and the cost of gasoline, steel and other essential commodities provide more than ample evidence. China Minmetals' bid for Noranda Inc, is yet another indicator. There is no doubt that we are increasingly influenced by China: not just in trade, but politically, culturally and socially. This is a major change, as despite Japan's industrial and economic influence, we are still accustomed to looking South or East for the flow of ideas.

Unfortunately China is still an enigma to most of us, even to those who spend much of our working time there, as is the West to most Chinese. It is an enigma based on geographic, historical cultural isolation[1], significantly contributed to by script, and by a large measure of mutual, and frequently politically motivated, prejudice. While the light of understanding is shining much more brightly these days, the Chinese appear to be making substantially more progress than we are in bridging the void. Simply compare the numbers of native born Canadians that can speak Mandarin or Cantonese with the number of Chinese who can function effectively in English, even if they have never been outside China. As the Globe and Mail article suggested, we need to do some catching up.

As Canadians we have a very slight advantage in dealing with China. Every Chinese school child knows of Norman Bethune, the Canadian hero of the Chinese revolution. Most also know of Mark Roswell, known in China as Dashan and famed for his comic dialogue on television. These two personalities have created for us an unparalleled fund of goodwill for Canada, which initially and superficially, puts us on the side of the good guys. There is, however a link between the Canadian agriculture and China that has persisted through periods of strong ideological differences to today's relatively relaxed political relationship. It has included trade in a variety of commodities including grains, livestock, forages and know how, and has involved a substantial number of people. It is perhaps well characterized in a comment made by an official in Jishou, a Dickensian phosphorus processing town in western Hunan Province, who remarked to me "most people relate to Canada because of Bethune. In my case, however, it is wheat. In 1960 we were on the point of starvation and then we received Canadian wheat and only because of that we survived".

There is no doubt that our agricultural sector will continue to expand relationships with China as a customer just as our other resource sectors are doing, and also as a supplier of goods and agricultural products. It represents a potentially very large and important agricultural trading partner. In that context it certainly behoves us to understand the Chinese agricultural system and the challenges and risks besetting it. Our competitors in the southern hemisphere are certainly not being slow to stake their claim there and we shouldn't be either.

2. The Agricultural Context

China has approximately 1.24 million km^2 of arable farmland, or about 7% of the global total. On this, which amounts to about 0.1 ha (0.25 ac) per person, it provides for 22% of the global population. To understand the factors involved in achieving this and the prospects for continuing to do so, an elementary geography lesson is essential.

In broad terms China has six major agricultural zones all of which are located in the east of the country. These correspond primarily to areas of major and, geologically speaking, recent, sedimentary deposition:

1. The N.E China Plain, extends through the Provinces of Liaoning, Jilin, and Heilongjiang, in the area once known as Manchuria. Here most of the better soils are of fluvial origins, deposited by rivers such as the south flowing Liao the northflowing Songhua-Heiliongjiang (Amur), and the Wusuli (Ussuri).
2. The North China Plain, whose focus is Beijing includes the fluvial deposits of the deltas of the Hai, Luan Rivers, and Hui rivers to the north in Hebei Province and the extensive delta of the Yellow River in Shandong and the most northerly part of Henan Provinces. These latter consist largely of redeposited, yellow coloured, loess from the interior, hence the name of the river.
3. The Central Plain is formed from the deltas of the Huai and Yangtze (Jiang) Rivers in Anhui, and Jiangsu extending into Zhejiang Province. This again consists largely of fluvial sediments.
4. The Middle Yangtze Basin is centered around the city of Wuhan, where the soils are also largely formed on extensive lacustrine and fluvial deposits.
5. The Chengdu Plain in the Upper Yangtze Basin in Sichuan, stretches from Chongqing to Chengdu, and the soils here are derived largely from weathered sandstones and shales.
6. The Zhujiang Delta of the Pearl (Xi) River inland from Hong Kong inland from Guangzhou in which the soils are derived primarily from fluvial deposits.

The soils of these regions have long supported a rich and varied agriculture. Their productive capacity created the food security that powered the early development of Chinese civilization and eventually supported one of the greatest population densities on earth. There is certainly truth in the Chinese saying that the Yangtze, the greatest of China's rivers, is the "Mother of China". These six regions also provided the power base of warlords and political factions that gave rise to the various dynasties, the last of which was the Manchu (Qing) Dynasty (AD 1644-1911). These basins continue to be the food baskets of China. They constitute the most productive component of the arable land area[2] by virtue of containing most of the irrigable land (535,800 km^2, or 42% of the total arable land).

The largest components of the country are either dry grasslands (60%) or mountains, or deserts (30%). There is some discrepancy over the exact area of grassland and while the Ministry of Land Resources report about 5.2 million km^2, other authorities report 4 million km^2 (43% of the land area). These are distributed in the following 6 regions:

1. The Northeast Prairie;
2. The Inner-Mongolia-Ningxia-Gansu Rangeland;

3. The Xinjiang Rangeland;
4. The Qinghai-Tibet Rangeland; and,
5. The Southern China Rolling Rangelands and Mountain Slopes.

Only about 2.91 million km^2 are exploitable (Datong, 1996), suggesting that there is about .22 ha (0.54ac) of rangeland per person. The difference could well be related to the assessment of what constitutes rangeland and what is desert - often a subtle distinction.

Climate is obviously the major determinant of agricultural patterns. In addition to soils and irrigation water supplies, cropping potentials are determined by the combination of precipitation and temperature which in turn are driven by latitude and a monsoonal climatic system. The dry, continental NW monsoon prevails through the Fall, Winter and Spring, tending to be particularly strong in the Spring in response to Pacific low pressure. This brings the infamous dust storms to NE China, and on occasion to the Korean Peninsula and Japan. In the severest cases in recent drought years, the dust has come clear across the Pacific to our own doorstep. Despite its negative connotations, this wind system may also be considered as the "mother of China". Over the millennia since the Pleistocene glaciations, it has deposited soils from the NW, onto the loess belt that extends through central and northern parts of the country. These readily eroded materials have in turn been redeposited by the major river systems to constitute the major soils of China's breadbasket (i.e. the NE and N China Plains, the Central Plain and the Mid Yangtze Basin).

The southeast monsoon from the Pacific carries moist air over the country during the Summer and is the major source of precipitation over most of the country. This starts in the Yangtze basin in March and arrives in the NE and the SW (Tibet) in July and August. Precipitation decreases from about 2000 mm/year in the extreme SE, with its semi-tropical conditions and dominance of paddy rice in the cropping system, becoming increasingly drier and cooler to the north and west.

Immediately over the Damaqun Mountins north west of Beijing, Inner Mongolia receives about 300 but this rapidly decreases to less than 75 mm towards the West. As conditions become drier in the north and north west crop agriculture gives way to extensive and traditionally nomadic herding, primarily of sheep and goats, but also of cattle and even camels in the drier areas. In most of Western Inner Mongolia, Gansu, Qinghai and Xinjiang agriculture is limited to isolated oases.

There is a general temperature gradient across the country from SE to NW. In the SE, semi tropical conditions prevail with average temperatures in the 25˚C range. Temperatures generally decrease to about 4˚C in the extreme N and NW. The exceptions are the Tarim basin in Xinjiang, which has very high summer temperatures, in excess of 40˚C and the Himalayas, the Tibet and Qinghai Plateaus and the extreme North of Heilongjiang in which average temperatures are subzero.

Rice, the crop that most people associate with China, dominates cropping systems south of the Yangtze where Indica varieties are prevalent. The consistently higher temperatures and more regular rainfall in the SE, enable a double or even triple crop in the Pearl River Delta. In Upper and Mid-Yangtze Basins rice/rapeseed or rice/winter wheat combinations become more common. In the lower Yangtze and Central Coastal Plain a variety cropping sequences prevail including rice/winter wheat, rice/soybeans winter wheat/rapeseed, winter wheat/corn. In the North China plain, in Shandong and southern Hebei, a winter wheat/maize pattern prevails, with the wheat harvest in mid-June. There is just enough time to squeeze in the corn crop so that it can mature before mid October. The turn around time between harvest and seeding is only two to three days and has been facilitated by the introduction of zero tillage. Cotton was once a very common crop in this area but fell into disfavour in the 1990s because of boll worm resistance to pesticides and the high cost of inputs. It has made something of a comeback in recent years mostly as a result of the introduction of genetically modified Bt varieties which significantly reduced pesticide costs. Not too far north of Beijing and throughout the N.E plains, single annual crops are the norm. Corn is the dominant crop through much of the area, but soybean, spring wheat and even some adapted cooler climate Japonica rice varieties are common throughout much of

the North East. As already mentioned, the dry northern and north-western plains have been traditionally used for extensive nomadic livestock production.

3. China's Agricultural Policies

The achievements of the Chinese agricultural system over the last 30 years have been substantial. Not the least being that it has managed to feed itself during a period of historically unprecedented population grown so that it now feeds almost a quarter of the world's population. The low point was in the chaotic years of civil war in the 1940s up to 1949. Although progress was made as the government focused on agriculture during the 1960s and 1970s the real turning point, came after 1980.

The Commune system was established in 1958 and had four major components: commune unit, brigades production units and households. It was implemented in conjunction with the state monopolised production and marketing system (SMPMS) which was aimed at providing cheap food for the urbanized industrial workers and cheap raw materials (e.g. cotton) for industry. It was characterized by: tight controls; rigid planning mechanisms; inefficient management rules & low production incentives. It was also very negatively impacted by the "great leap forward" Mao Zedong's misguided attempt between 1958 and 1961 to instantaneously match Western industrialization. Labour was diverted into backyard pig iron production, leaving fields unplanted, untended and unharvested. The subsequent shortfall in the food supply resulted in what has variously been estimated at between 16 and 55 million deaths by starvation. It also, incidentally, led to widespread environmental degradation as forests were hacked down to fire the furnaces and as household or communes tried to find enough fuel for domestic purposes. Things improved markedly in the subsequent years of the communes, despite the Cultural Revolution (1966-1976), but still involved huge production inefficiencies. From an economic development point of view the immobility of labour linked to the residence registration (hukou) system was a major constraint. This facilitated political control and kept people in rural situations and not necessarily where there was a need for labour.

The household production responsibility system (HPRS). The turnaround came with the introduction of the household responsibility system under Deng Xiao Peng and the dismemberment of most, but not all state farms. The HPRS replaced communes in the early 1980s . The decision to introduce this system was made at the third Plenary session of the 11th Party Conference of China's Central Committee in 1978. Reorganization didn't start until 1982, but by the end of 1984, 95% of communes had been disbanded.

Initially HPRS was envisioned as a system for contracting specific production to the commune households for specialized crops such as cotton. It was supposed to encourage farmer's to cut costs, take risks and enter new lines of production. It was also intended that they be motivated by profit. The system was first introduced in inland areas and later extended to oil seeds and grains as it spread from inland areas to coast.

It had two major shortcomings: (i) household rights were unclear, leading to disputes among families and also with village leadership; and (ii) the short (15 year) term of the land use rights contract provided no inducement for farmers to make long term investments in the land. The farmers preferred instead to make short term investments in possessions over which they had control, rather than in land improvements or tree crops. The introduction of the HPRS did, however, free farmers to find employment outside agriculture.

The contact term was extended to 30 years (50 years for grasslands) in 1994. This was aimed at increasing trust in the policy and encouraging longer tem investments in the land and was partially successful. The residue of the old system still lingers on, however, and still to some extent impedes the achievement of high levels of efficiency in China's agricultural system. Given the dependence of 70% of the population on the rural economy, it is questionable whether immediate priority should be given to the achievement of high levels of efficiency or to the provision of a source of employment, at least until viable employment alternatives can be developed.

Although the HPRS has been successfully applied in arable areas for the last two decades it has still not been universally applied or accepted in the grassland areas. There are a number of reasons for this. The principal one appears to be that the policy was devised and initially implemented as an arable farming model. It has not been readily accepted or adapted to by herders whose lives are driven by quite distinct production imperatives and traditions. A strong case is made by Banks et al., (2003) and many other rangeland specialists for community based arrangements and of the need for institutional innovation and open mindedness in applying policies such as the revised Grassland law of 2003, which will be discussed later.

The concept of rural industry, re-introduced in the mid-1980s, has for long been seen as a means of removing or employing surplus rural labour. By 1987 the gross product of rural industries surpassed that of all agricultural output in 1987 (Tuan et al., 2004). However, it has been plagued by problems which include electrical power shortages, lack of investment, lack of raw & processed materials, poor banking services and poor transportation and communications. Worst of all probably are the horrendous environmental conditions associated with many rural industries. Some, such as local paper manufacturing, were so destructive that the government was forced to take drastic action to close most of them down. Others, such as the primitive coke ovens that dot the landscape of Shanxi province and fill the air with thick fumes are probably as bad an example of inadequately regulated industry as can be found anywhere.

4. Achievements

As already mentioned, China's success in attaining and maintaining self reliance in food crop production has been a huge achievement. It represents increases of 205%, 652% and 335% for paddy rice, wheat, and corn respectively. This was achieved through the massive investment during the later part of the collectivization but also undoubtedly through the introduction of the HPRS and the incentives this provided to individual farmers. It was also accompanied by changes in crop production, which included: substantial mechanization, improved crop breeding and increased use of fertilizers. In the case of vegetables the increase of about 740% since 1975 has been even more spectacular than for other crops. The major contributor to this has been from the introduction of simple, cheaply constructed, plastic greenhouses surround most cities. These now surround and are an essential element in the food supply chain for the cities. Any older Chinese person will readily confirm the abundance of vegetables today in comparison to 20 years ago and the difference this has made to the winter diet.

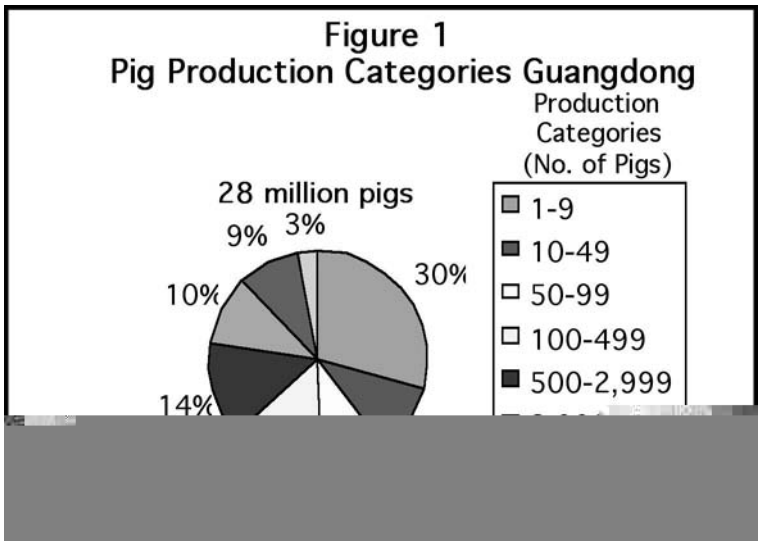
Mechanization started in 1950s and has been well documented in English in William Hinton's book Iron Horses[i]. It involved the introduction of very simple and robust 10 to 20 hp, 2 wheel or 4 wheel diesel tractors pulling small equipment that are now ubiquitous throughout China. These have greatly eased the work of farmers, have created the basis for custom contracting and provide basic utilitarian transportation for goods and passengers. This is particularly so in remoter regions such in the NW, Gansu, Qinghai, Xinjiang and Tibet where road conditions are often poor and communities quite isolated.

Most of the credit for the yield improvements over the past 30 years must be attributed to the work has been done by Chinese agronomists. For instance, Peng et al (2004)[ii] provide a good account of what they describe as the quantum leaps that have been achieved in rice yield improvement by Chinese scientists since the 1950s. They present the case of the development of "super" rice varieties which, on large planting areas of at least 6.7 ha, yielded 9-10.5 t/ha in 2000 and are expected to reach 12 t/ha by 2005, and 13.5 t/ha by 2015. Chinese researchers have, however, cooperated with international research institutions of the Consultative Group on International Agriculture Research (CGIAR) network including IRRI in the Philippines on rice production, CIMMYT in Mexico for corn and wheat and with CIP in Peru for potatoes. Some has also been done by international agribusiness companies such as Monsanto, which has for instance, introduced and actively promoted its Bt cotton varieties.

Fertilization has played a major role in increasing agricultural production. It has been heavily subsidized and promoted through very aggressive, if not always appropriate programs. Average utilization of N fertilizer is now approximately 211 kg/ha and in intensive production for vegetables as an example, applications exceeding 500 kg/ha are common (Zhang. W.2001[iii]).

Other very effective practices facilitated by the availability of plentiful labour have included the widespread use of mulches to extend the growing seasons, reduce risk of crop loss and in some cases to achieve the production of crops in areas which might otherwise be climatically unsuited for them.

Increases in the production livestock have been equally impressive since 1960. Pigs started off providing in excess of 70% of animal protein, so the 78% increase in production that has been achieved since that time appears to overwhelm those achieved in ruminant production. In fact, cattle and sheep numbers have increased by about 83 and 52% respectively and increases in poultry production have been even more spectacular at about 460%. In the case of both hogs and chickens the rapid expansion of numbers has coincided with the conversion from back yard production to medium and large scale intensive production over the last 20 years or so. The rough composition of hog production by farm size category in Guangdong Province, a major production area, is shown in Figure 1. This suggests that small scale operations with less than 50 animals now only account for 40% of production while medium sized, or specialized family, operations with 50 to 3000 animals account for 38% and large scale operations with 3,000 to more than 50,000 animals produce about 22%



Dairy production has also expanded hugely in the last 10 years so that milk and milk products are available almost anywhere in the country. While milk processing is done primarily by three large companies, production is mostly in the hands of small scale producers having at most 5 or 6 cows and frequently fewer. This creates enormous collection and hygiene maintenance problems that are mitigated to some extent by the formation of dairy villages with communal milking barns.

Canada has certainly contributed to China attaining and maintaining food self sufficiency through 7 major technical assistance projects which involved the investment of some $117 million over the last 20 years:

- **The Fertilizer Project** in which PPIC in collaboration with Professor Jin Jiyun and the staff of the Soil and Fertilizer institute in the Chinese Academy of Agricultural Sciences have made significant inroads into improving fertilizer management practices, through spreading the gospel of balanced fertilization.

Not only is the quality of water in the aquifers in the N. China Plain and elsewhere being compromised, but there is also widespread depletion of these major water resources. This is well documented by Kendy et al (2003)xviii who show a drop from 40m ASL to about 19m ASL during the 1976-2002. This is also widely observed by irrigators and other water users throughout the N China Plain. There is a dual cause to this situation: (a) the volumes of water abstracted annually to support irrigated agriculture, industry and domestic use throughout the N. China Plain; and (b) the fact the so much water is diverted from the rivers and streams entering the N. China Plain that recharge to this major regional aquifer is highly compromised. In fact the Yellow River that it is now failing to reach the sea, except in the most severe flood situations. Drought situations, probably linked to global warming, are contributing to more rapid evapotranspiration which is accelerating the process of groundwater depletion.

There have been other more short-term environmental concerns associated with agricultural intensification. In the crop sector, these include smoke from the burning of crop residues and the accumulation of plastic from land mulching. Burning of crop residues is a custom and in many multiple cropping situations where time between crops is of the essence. In the North China Plain it is done to remove the wheat crop residues as rapidly as possible and to facilitate the seeding of the summer corn crop and also to save the substantial labour of removing unwanted corn residues. In recent years it has been strongly discouraged by the State Environmental Administration, which appears to have been having substantial success in reducing the amount atmospheric pollution that used to occur in mid-June and again in mid-October. White pollution, as the accumulation of plastic mulch is called, continues to be a problem and has defied any simple solutions short of insisting that farmers collect it up at the end of the year or even placing a recycling value on it. So-called biodegradable plastics (i.e. plastics manufactured with a starch matrix) only appear to complicate the problem as they fragment into small particles that defy collection and remain in the soil.

The intensification of livestock production that has contributed so greatly to the huge increases in China's livestock numbers is not without peril. The disposal of manure has become a major problem in the livestock sector and particularly with the intensification of hog and poultry operations, but also to some degree with the beef and dairy operations. Disposal practices from these operations have yet to be effectively regulated. There is legislation in place, borrowed to some extent from the Alberta model, but which specifically exclude the plethora of smaller operations. However, the gap between promulgating regulations and achieving compliance has yet to be effectively bridged, and much manure is simply disposed of into waterways, destroying the aquatic environments and eventually finding its way into the sea. The concern over the impact that elevated nutrient levels of nutrients are having on the South China Sea, has prompted the World Bank and FAO to seeking GEF funding to try and resolve the situation, starting with Guangdong Province in China, but also including Vietnam and Thailand in a regional initiative.

The potential for the spread of communicable livestock and zoonotic diseases are also a major threat, of which the recent outbreak of avian flu was a clear warning. Foot and mouth, hog cholera and Newcastle disease have all been experienced in recent years and the potential for viral mutation human patogens remains strong. Fortunately after the SARS experience China has radically altered its approach on disease reporting and has replaced the previous secretiveness with a policy of openness

Another major issue for government has been the size of the subsidies on agricultural products required to maintain urban low food costs. Quoting here from Tuan et al (2004) - *These grew from 8 billion Yuan in 1979 to 24 billion (excluding a 4-billion subsidy to import agricultural commodities) in 1987, and ballooned to over 44 billion in 1997 and about 55 billion in 2002. Before the government abolished the food grain rationing system in urban areas in 1993, most of the subsidies went to city consumers. In more recent years, government subsidies began to flow to money-losing state-run enterprises. The bad loans of the grain bureau system reportedly totalled 120 billion Yuan by the end of 1997 and 200 billion by the end of 1998.* The reform of this system is currently underway and consumers in China's cities are noticing a appreciable increase in the consumer prices, although this does not appear to be reflected in official data.

While the loss of arable land is a major concern, so too is that of the grasslands. The major causes of this are overgrazing[5] and loss of biodiversity[xix], leading to wind erosion. Once again, the combination of poorly structured, erosion susceptible, loess soils, frequent and prolonged drought and high spring wind velocities contribute to making much of the north and northwest grasslands highly susceptible to erosion. Some 90% of grasslands, amounting to about 40% of the national territory, are degraded to some extent (Banks et al, 2003)[xx]. In 1997, the International Centre for Integrated Mountain Development (ICIMOD)[xxi] estimated that 866,700 km^2 of grasslands, or one third of the nation's total, had already suffered severe degradation resulting in a 30 - 50 percent reduction in grass yield. They estimated that the productivity of China's pastoral areas was only 5 to 10 percent of that in the USA or Australia and predicted that if present trends continued, grassland yields would be reduced by another 30 percent by the year 2000. Given that 2004 was the only non-drought year in the last three, it is hard to see how the prediction could have failed to be fulfilled. The future prospects for the grassland do not appear to be good as global warming accelerates the degradation process. The Intergovernmental Panel on Climate Change[xxii] indicates that the number of days each year when windstorms (winds with velocities greater than 17.2 m/sec) occur can average 20–40 days per year in arid regions and 10–25 days in semi-arid regions, but more than 100 days/year in most affected areas. These numbers may well increase under global warming because dryer and stronger-wind conditions are expected, resulting in accelerated soil degradation. As noted previously, these sandstorms can carry particles into the jet stream and right across the Pacific.

6. Responding to the Challenges

The higher levels of government and many academics are acutely aware of the structural/administrative and resource challenges facing the agricultural sector. They are also cognizant of the consequences of failing to respond adequately to these. The success of China's agricultural system to feed the country, and employ a large rural population will ,more than anything else, determine whether this is to be China's Century or not. Failure to achieve this will likely have global impacts, simply because China has such a large population. It will at very least lead to huge increases in food costs and severe hardships for less wealthy grain importing countries. At the most extreme it could well lead to more desperate rural conditions resulting in generalized unrest the results of which are beyond prediction, but are unlikely to contribute greatly to world peace and harmony.

The major task facing currently facing government is that of restructuring the rural economy from being largely agricultural to being largely oriented to manufacturing or service industries. The scale of this challenge was quantified by Zhang Hongyu of the Ministry of Agriculture[6] in 2003. *"China has 480 million rural labourers, of whom 320 million are involved in agriculture. Even at current production standards only 170 million are required, leaving a surplus of 150 million people".* Means obviously have to be found to make the most of manufacturing opportunities and service jobs for this surplus population, while increasing the scales and efficiency of agricultural production and involves the most motivated and competent farmers. This is not a new problem and, as already indicated, rural industry has been considered as a measure for removing or employing surplus rural labour since the mid-1980s, even if the environmental impacts of doing this were frequently undesirable. The fact that since 1970 the share of the agricultural sector in the economy fell from 40% to 14.5% and its share of employment fell from 80% to less than 50% (ADB 2004)[xxiii] indicates that the move away from the rural areas is part of an ongoing process. In the same report cited above (see footnote 4), it is stated that in 2002, 94 million farmers left their hometowns to find work elsewhere. Certainly, while working in the village of Chenliuying in Handan Municipality in southern Hebei Province, we observed that farmers frequently took over the production contracts from neighbours who had alternative employment on a store cropping basis. Those remaining also appeared to be the more competent and self assured farmers.

China's WTO accession is obviously very important in the effort to expand industrial employment and absorb the huge numbers of unemployed and underemployed from rural areas. This partially explains China's enthusiasm to join this body. In the short term it puts Chinese grain farmers and livestock producers at a

disadvantage in comparison to more efficient producers from N. America, Australia and Argentina. In the longer term, the government of China appears to be betting on maintaining production levels and strategic stocks through changes to the physical and social infrastructure, important elements of which are:

- increasing the efficiency of irrigation water use and expanding water distribution infrastructure through schemes such as the South-North Yangtze River diversion project;
- improving transportation access;
- liberalizing markets for agricultural commodities (although grain prices are still regulated);
- improving farmers access to bank credit, which at the moment is largely unavailable because: (i) farmers have little to offer as collateral; and (ii) the banks have little interest in providing rural credit;
- introducing structural changes, primarily to reduce direct land dependency and provide opportunities for better farmers to achieve greater production efficiencies;
- increasing crop yields through breeding and better fertilization;
- increasing livestock productivity particularly that of pigs, cattle and poultry;
- reducing erosion through tree planting and improved tillage practices;
- increasing food safety and quality to facilitate the export of crops, such as fruit and vegetables in which it has a competitive advantage;
- increasing rural people's access to educational opportunities and training; and,
- improving rural medical services.

To achieve these will require the development of a comprehensive regulatory regime to support modernization of agriculture & comply with WTO commitments. Key policies taken is support of this objective in the previous three years include:

- Amendment in March 2003 of the 1993 Agricultural Law to accelerate the transfer of surplus rural labour; ensure safety of farm produce; and advance agricultural science & technology development;
- Revisions to the water law in 2002 to provide a legal framework for water pricing and cost recovery and to facilitate more efficient and effective management of the resource; and,
- Revisions to the grasslands law of 1985 in order to provide a better framework for the management of the grassland and to complement the Anti-desertification law (2001).

The government has taken immediate steps not only to try and reverse the slide in grain production but also to stem concerns over the rural-urban income disparity and the resentment over land conversions, which have been referred to previously. In this regard a key piece of legislation was passed during the 2nd Session of the 10 People's Congress March 2004 named No.1 Decree on Raising Farmer's Incomes. This consisted of 6 practical measures including:

1. Raising farmers' incomes by 50% in 2004 from Rmb 2,574 to 2,702 (i.e. from approximately US$ 311 to 327) and by reforming rural taxes and administrative charges which will be reduced annually and scrapped altogether within 5 years;
2. Increasing the profitability of grain production by providing subsidies to farmers for the purchase of seed for high yielding grain varieties;
3. Facilitating rural residents to work in cities through liberalizing the control of farmers and promoting free migration;
4. Promoting the restructuring of the agricultural and rural economies and encouraging the creation of township enterprises;
5. Strengthening farmland protection to maintain grain production; and,
6. Reforming the land requisition process to safeguard farmers land rights.

Several of these policies have already been put into effect. For example, during the previous wheat harvest in June it was announced that the Government would be halving agricultural taxes from 4 to 2 percent and that

it would raise the selling price of wheat by 60% (i.e. to $1.30/kg). On September 10, 2004 an increase in subsidies for the purchase of high quality grain seed was announced and the number of grain producing regions entitled to this financial support was increased from 9 to 13[7].

Specific measures are also being taken under the longer term policies mentioned above to mitigate the impending problems. Under the revised Grasslands Law the Government has committed to spend Rmb 26 billion (US$3.1 billion) on rangeland restoration. As part of this winter/spring grazing bans are now applied in parts of Inner Mongolia and Ningxia, Gansu, Qinghai, Xinjiang and Tibet. These are designed to take the pressure off the more intensively used rangeland during the period that they are under the greatest stress and to allow a period of recuperation in the spring. Its imposition requires a major behavioural change by the herders, particularly that of growing, harvesting and storing hay. While this is becoming an increasingly common practice, there are still problems of ensuring that adequate areas are reserved for this purpose and that they are harvested early enough in the year to retain their potential nutritive value.

In the arable areas the Ministry of Land Resources (2004) has established a program for the rationalizing land use and through a process of land consolidation. These take two forms:

- government driven initiatives to reduce the number of fragmented parcels of land divided by field ridges, roads and irrigation ditches; and,
- motivating more efficient and committed farmers taking over production contracts from other less interested or otherwise employed farmers on a crop sharing basis, such as that already mentioned for Chenliuying Village.

Both measures increase scales of production and contribute to efficiency. However, while the first is, unlikely to make a huge difference in the short term, the second is likely to provide an important key to the future success of China's agriculture, but is closely tied to China's ability to provide alternative employment to its huge numbers on unemployed or severely underemployed rural labourers.

Conclusions

In this paper I have attempted to provide a glimpse of the land and water resources and climatic conditions that provided the basis for the development of one of the world's most prolific agricultural systems and based on this, one of its greatest civilizations. I have also attempted to provide some insights to the socio-political conditions under which Chinese agriculture currently operates and the precedents to this. It is obvious that the sector is undergoing a transformation of a magnitude never witnessed anywhere else. The absorption of 150 million people (4.25 times Canada's total population) from rural to industrial or service industries is a mammoth and unprecedented task. Many of the social and political issues involved with this are being actively tackled with varying degrees of success. The degree to which it will succeed depends more than anything on the prospects for continued growth of the Chinese economy. This in turn depends on:

- the global readiness to absorb the products of Chinese industry, which is something leaders of other countries, both economically developed and undeveloped, may increasingly view as a threat and try strenuously to discourage.
- China's political leaders making the decisions and providing the leadership that permits this transformation to continue happening; and
- the continuation of a political environment that permits them to focus on this transformation without significant external distractions.

The success in this grand and rather risky venture requires a great determination to stay the course by politicians and leaders as well as by the population at large. Signs of strain are already showing as evidenced by the article by Joseph Krahn cited previously and could result in public unrest. This is internal situation is obviously a great concern to the leadership and could cause them to blink for long enough to lose their

concentration on the principal task. There are obviously a number of external threats as well, not the least of which is the state of the international economy and the prospects for the Rmb, which has for long been pegged to the US dollar.

Food security and self sufficiency continue to be dominant and central themes of China's agricultural policy, although more attention is now being paid to the issues of food quality and food safety in addition to quantity. The determination to provide at least 95% of grain requirements nationally should be some comfort to the rest of the world, because a failure to achieve this will have global consequences. It may benefit Canadian farmers in the short run, but in the longer term, grain deficits, global price increases and hunger may well be excessively disruptive to global peace.

The great imponderable in all this and the one that is largely beyond the scope of the political decision making process, is the extent to which natural phenomena will drive events. This paper has taken pains to emphasise the link between nature and distribution of China's land and water resources and the agricultural system. It is evident that, the extent to which these resources are currently being exploited and the fragility of many systems is already a cause for concern. To some extent China is on a knife edge with respect to the ability of its natural resources to continue supporting the population and enable the transformation it is going through. More than anywhere else in the world, unexpected or undesirable phenomena can have immense and far reaching impacts. The impacts of widespread drought, floods and human disease have all been experienced in the last few years and despite their scale, the people of the affected areas have been able to shrug them off and get on with life. However if there is increasing frequency of drought in the North and North West or of violent weather patterns in the South East linked to global warming, to which China is a major contributor, the effects may be more difficult to overcome. In similar vein, the occurrence of another communicable disease episode on a greater scale than the SARS outbreak, which brought much of China to a complete halt for a three month period could also have a profound effect depending on its severity and duration. Events such as these could well disrupt and delay the process of social transformation: at worst they could seriously disrupt agricultural production and create an unprecedented drain on the world's grain and food supplies. As we have recently witnessed in S.E. Asia no amount of political wisdom is going to entirely avoid the occurrence of disastrous natural events, although foresight and anticipation can certainly do much to lessen their impact. Whether this century belongs to China, as suggested in the Globe and Mail article referred to in the introduction, will therefore depend not only on political vision, foresight and leadership, but also on a great deal of luck. – Luck, not just for China but for us all and our children as well.

7. Footnotes

[1]For instance after the seven epic voyages down the African Coast and over possibly to Australia by the Chinese admiral Zheng He (Cheng Ho) ended in 1433, the Ming Dynasty turned inward. It forbade further voyages of exploration and even contact with other countries. This isolation continued quite unabated until the 19th century.

[2]There are huge discrepancies in estimates of the amount of arable land which range from a low of 9.3 million km^2 to 13.9 million km^2 and some suggestions that the true figures my be purposely obscured (Mackenzie 1998).

[3]The extent of the possible shortfalls is difficult to gauge as there is uncertainty over the size of the stocks held by China or of how long it can continue to release them to meet domestic needs. (OECD Agricultural Outlook 2004-2013. P 15)

[4]Despite this, in response to the Regulation on the Protection of Subsistence Cropland (State Council 1994) under which cropland used for construction should he offset by setting aside land elsewhere, fast growing coastal provinces pay other provinces- mainly in N & NW to plough new land. The results are reported to be generally unsustainable and to contribute to soil erosion (Wang et al. 2004).

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[5]The issue of analyzing the social causes for overgrazing is fraught with emotional overtones and is something of "can of worms". However, it is safe to say that populations of the traditional herders in the grassland areas have expanded considerably over the last 50 years (China's one child policy does not apply to these rural minorities), which has resulted in a huge increase in livestock and added pressures on the rangeland, assuming that the number of stock required to maintain a family has been constant or expanded. Also during his time, huge socio political changes have occurred and caused the abandonment or deliberate alteration of many of the preexisting constraints to overgrazing and the maintenance of biodiversity (Foggin and Smith 1996)[xix]

[6]Xinhua News Agency April 3, 2003

[7]This is the first time that subsidies have been paid to farmers and is in marked contrast to the past practice of applying subsidies were applied through the procurement system, under which farmers had to provide contracted quotas at government established prices often below the open market price.

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