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Foodgrain Production Instability in China and the World Grain Trade

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FOODGRAIN PRODUCTION INSTABILITY IN CHINA AND THE WORLD GRAIN TRADE

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Preface

This paper was presented in the session "The World Food Situation and Prospects" of the Seventh World Congress of the International Economic Association held on 5-9 September 1983 in Madrid, Spain. I am grateful to the Centre for Contemporary Asian Studies of The Chinese University of Hong Kong for obtaining a faculty grant for the research, and the New Asia Ming-Yue Foundation of the University for providing a travel grant for the presentation in Madrid.

The subject matter of the paper is grown out of a larger research project which covers the long-term agricultural instability in China from the 1930s to the present days. This paper attempts to examine the relationship of foodgrain production instability in the post-1949 period with weather disturbance and the government's rural and agricultural policies. Against the background of the past performance I shall also show how changes in consumption policy, population growth rate, and weather disturbance may bear on China's grain trade with the outside world in the future. Given the limited space, it is obvious that all these problems can only be dealt with in a rather general fashion. In fact, the present paper is a synthesis of my other papers listed overleaf which interested readers may like to consult for more detailed discussion and the statistical sources of the Tables and Figures presented in this paper.

I am grateful to Dr. Robert Ash for his helpful comments and suggestions and for improving the readability of the manuscript. I am of course solely responsible for all the errors that remain.

Y.Y. KUEH

Related Articles by the Author

"China's New Agricultural-Policy Program: Major Economic Consequences, 1979-1983." Journal of Comparative Economics, Vol. 8, No. 4, December 1984, pp.353-375.

"China's Food Balance and the World Grain Trade: Projections for 1985, 1990, and 2000." Asian Survey, Vol. 24, No. 12, December 1984, pp.1247-1274.

"China's Foodgrain Production, Consumption, and Trade: Recent Trends and Prospects." International Review of Economics and Business Vol. 31, No. 9, September 1984, pp.910-926.

"Fertilizer Supplies and Foodgrain Production in China: 1952-1982." Food Policy, Vol. 9, No. 3, August 1984, pp.219-231.

"Weather, Technology, and Peasants' Organization as Factors in China's Foodgrain Production, 1952-1981." Economic Bulletin for Asia and the Pacific, Vol. 34, No. 1, 1983, pp.15-26.

"A Weather Index for Analyzing Grain Yield Instability in China: 1952-1981." The China Quarterly, No. 97, March 1984, pp.68-83.

Introduction

With the necessity to feed a population which accounts for some 23% of the world total, China inevitably acts as an important factor in the world food situation. According to FAO Statistics, it produced 286.1 million metric tons of cereals, or 17.2% of the world total, in 1981. It is by far the largest rice producer accounting for 35.3% (or 39.1% in 1982) of total world output. Its share of wheat production (12.4%) stands only next to the Soviet Union (19.2%) and the United States (16.6%).

Thus, even small relative changes in China's food balance may translate into large magnitudes of imports or exports and seriously affect the world food trade. In 1980, for example, China's wheat imports amounted to 12.26 million tons (or 12.4% of total world imports), second only to the Soviet Union. Its share (10.31%) of the world's rice exports was exceeded only by the United States (24.0%) and Thailand (21.6%). Taking all traded cereals together, China was a net importer in 1980, ranked (with 16.42 million tons) third after the Soviet Union (28.95 million tons) and Japan (23.65 million tons). But interestingly, its total net imports amounted to only 5.7% of its domestic production, again, according to FAO Statistics(1).

Now how would China fare in the world food market, say, up to 2000? This question necessarily raises the problem of its domestic production and supply security. With this in mind, I shall first attempt to isolate the technological and socio-economic factors that have contributed to improved production stability in China during the past 30 years; and examine to what extent they have done so. The focus of this paper, however, will be on the recent agricultural policy changes and their possible impact on the growth and stability of production; and thereby on the international grain trade.

The weather is obviously a very important dimension which enters into the multifaceted relationship between production performance, technologies, and socio-economic policies. Nevertheless, in most studies of China's food production, it is the least investigated factor, rarely considered beyond passing remarks about the overall weather condition. In this paper I shall make use of an agricultural weather index to measure the degree of production instability from 1952-1981 in the hope that the observed pattern may shed some light on the future production performance.

Sources of Grain Production Instability

There are many factors which cause or limit the range of overall output fluctuations. Generally speaking, they fall in one of two categories, affecting yield per hectare sown, or the total acreage sown or harvested. The yield determinants include essentially weather conditions, the intensity of use of modern inputs (chemical fertilizers, pesticides, etc.) and technologies (irrigation, mechanization, etc.), peasant incentives, and the farm-organizational suitability or ability to cope with natural disasters.

The size of sown acreage is also subject to a host of influences. Prices may change, for example, in favour of cash crops. In the context of a planting acreage designed to complement or facilitate the implementation of the compulsory procurement scheme, a reordering of the government's siphoning priorities may imply a reduction in grain acreage. In addition, planned acreage may have to be discarded, if for lack of adequate drainage facilities serious flooding results in long-lasting inundation. Likewise, the absence of summer rains under a prolonged drought in the North China plains (as in the case of 1959-61) may prevent the regular leaching of salts which normally accumulate during the dry months of the preceding winter and spring, and so render wide stretches of farmland unusable(2).

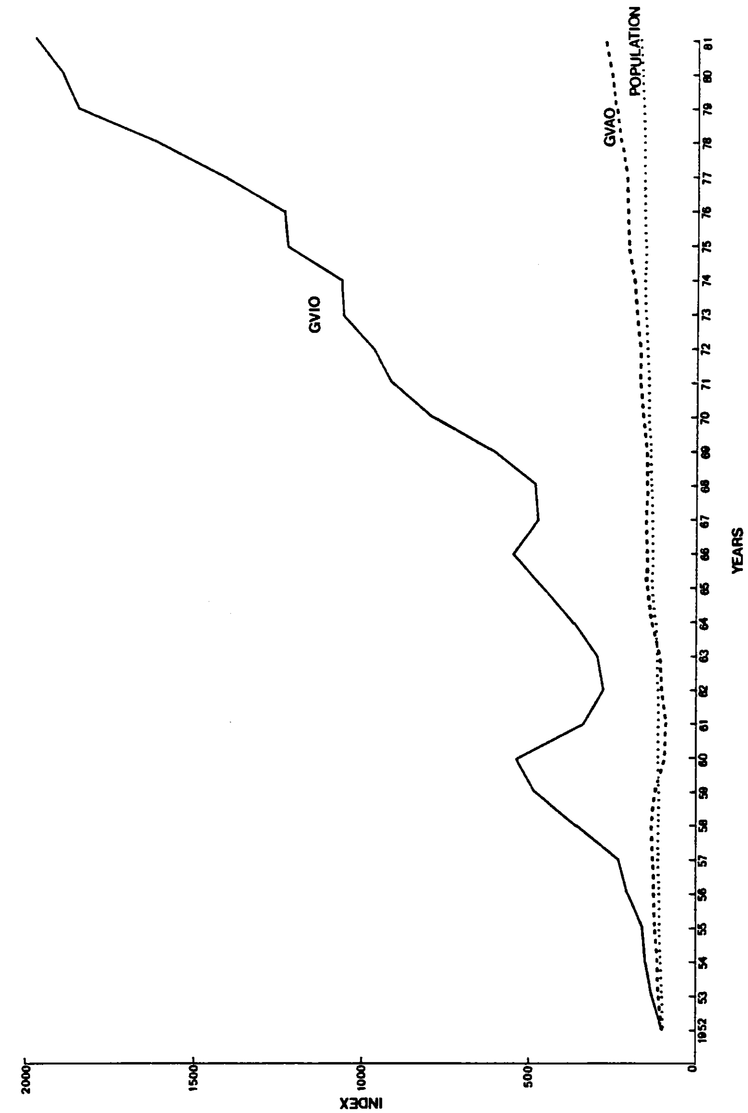
Paucity of data makes it impossible to statistically verify the extent of acreage losses caused by such comparatively serious weather factors. Overall, the total grain sown acreage in China has remained quite stable over the years(3). Indeed, within the virtually nonmonetized rural context of China the strictly imposed system of compulsory farm delivery quotas (at officially-fixed prices) has basically denied peasants' expression to price-supply elasticities, except perhaps for a short episode of relaxation during the decentralization drive of recent years(4). It has also been the Chinese government's deliberate policy to maintain a stable grain acreage. Given, however, the extreme scarcity of land, the arable area has gradually been curtailed, in order to accommodate the needs of industry and housing, and it has accordingly been necessary to raise the multiple-cropping index for cash crops as well as grains.

The outcome of these competing forces is obvious. With sown acreage kept constant, per hectare yield must be steadily increased to keep pace with food requirements of the growing population and to generate a sufficient surplus to sustain the desired industrial expansion. These strategic quantitative relationships are clearly reflected in Figure 1.

Discussion of the Chinese development strategy is beyond the scope of this paper. But it should be briefly noted that under the enormous policy pressure to accelerate the speed of industrialization and maximize investment in the heavy-industrial sector, both the supply of modern inputs to the agricultural sector and agricultural growth itself are bound to be constrained. This will prove an important dimension to our subsequent discussion of the nature and implications of the recent agricultural policy changes.

To return to the problem of production instability: with sown acreage basically fixed, per hectare yield variation is evidently the single most important cause of yearly production fluctuations. A number of possible sources of yield variation have been cited earlier. Increased adoption of modern inputs and technologies raises the yield level over time, but it does not eliminate year to year yield fluctuations. The same applies to policy and organization changes and the effect on peasant

Figure 1. Population, Gross Value of Industrial Output (GVIO), and Gross Value of Agricultural Output (GVAO) in China, 1952-1981 (1952 = 100).



incentive which they imply. Such human elements may bear on the pattern of yield movement over the longer run basis but they seem to provide a less adequate explanation of short-run fluctuations. In fact, the strong subsistence urge of the Chinese peasants conditioned by the strictly controlled locational and occupational mobility acts as a powerful harvest stabilizer. Since failure to consider the vagaries of weather would indeed be suicidal.

Weather Variability and Yield Instability

The above discussion suggests that weather variability may be the most important source of yield and output instability. To gauge the weather impact on yield involves the most complicated task of compiling a meaningful agricultural weather index for China. Even if precipitation and temperature data were available, any hydro-thermal index and cumulative temperature index compiled at the national aggregate level would probably be of little use for a country with such a vast territory and such great climatic variations(5).

Fortunately, Beijing has recently released an almost complete series of data for the size of sown areas affected by natural disasters from 1952-1981 (but excluding 1967-1969)(6). These national area aggregates clearly represent a more accurate measurement of the average climatic changes, for they have been obtained through stepwise vertical aggregations of local data which have themselves been collected as an integral part of the

regular procedure of yield and output prediction and measurement. To ease our task, the time series also allows a distinction to be made between areas which have suffered grain losses of above, and below, 30%, or to use the Chinese terms, between "chengzai" (affected) area, and "shouzai" (covered) but "non-chengzai" (unaffected) area respectively. As such the area series really solves the problem, to borrow Anthony Tang's term, of "our ignorance of crop-specific, location-specific weather and yield relationships in agriculture"(7).

In deriving the following agricultural weather index (Figure 2) I have accorded the two types of disaster-area with a weighting ratio of 1:4, and used the long-term 1952-1981 (again 1967-69 omitted) mean of the weighted series to determine the yearly percentage deviations(8).

Such an independent index represents not only a more operational measurement, but evidently a more accurate one as well, compared with the more familiar approach, such as that adopted by Tang (Figure 2), of classifying each year since 1952 as a good, average or poor year(9). One of the interesting points to emerge from our index is that only for three years (1956, 1957 and 1976) are the area deviations within 10% of the 27-year mean. This conclusion is very similar to that drawn from crop weather studies for the US Corn Belt States(10). In any case it seems apt, as McQuigg, Director of the US Center for Climatic and Environmental Assessment, suggested, not to speak of "average weather", but of the "large scale, long-term variability

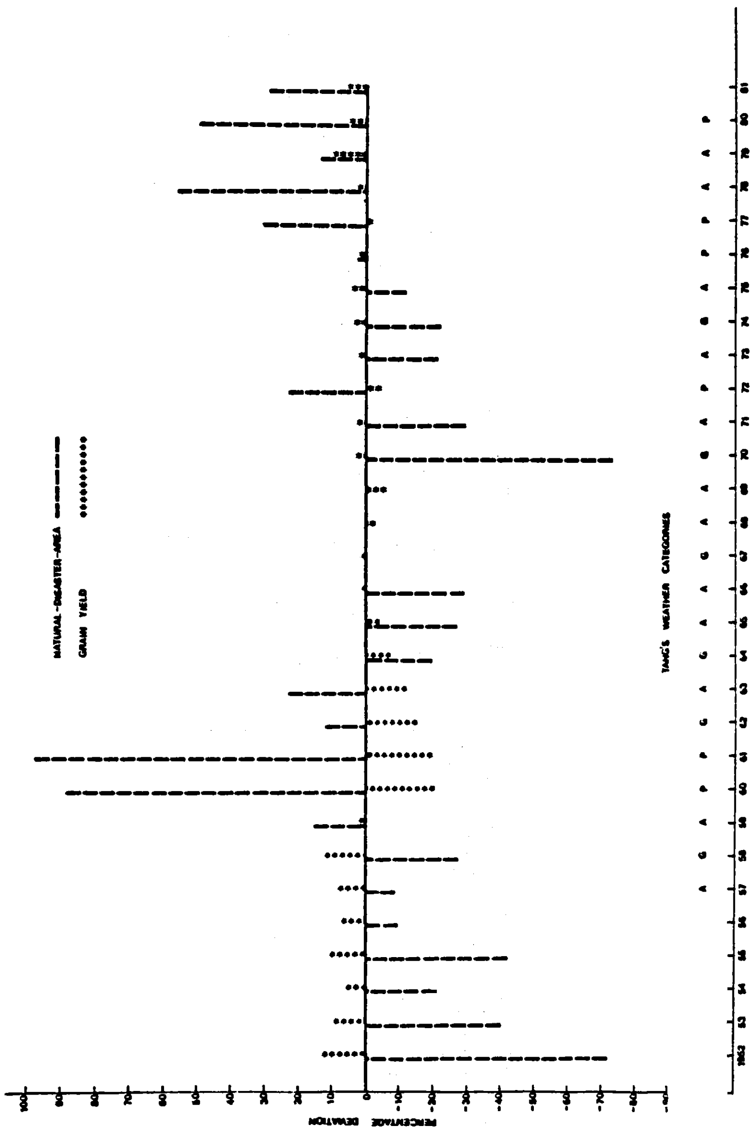


Figure 2. An Agricultural Weather Index for China in Relation to Grain Yield Instability, 1952-1981.

of weather events from year-to-year or from decade-to-decade"(11).

Another interesting point is that in addition to the relatively large annual variability, there is a clear pattern of long-term movement which correspond to the usually perceived decadal weather cycles. Specifically, nearly a decade of favourable weather in the 1950s gave way to large scale disasters in the early 1960s. There followed a gradual improvement until 1970, when the weather entered again into another decade of deterioration resembling much the pattern of the 1950s.

Now how does the per hectare yield fare vis-a-vis the observed weather variability? I have first of all used the log-linear path to isolate the technological influence. Such a linear path basically reflects the Chinese trend in the application of chemical fertilizers, and the approach used here is indeed very similar to the much celebrated studies done by Thompson on the weather/yield relationship in the US Corn Belt States(12). The yearly percentage deviations of grain yields from the log-linear trend value as shown in Figure 2 clearly reveals a rather close relationship between weather variability and yield fluctuation. This is especially so for the earlier period 1952-1966, when irrigation and drainage capacity had not yet been adequately built up compared with the 1970s.

A multiple regression of the grain yield series on the area series with the lagged (by one year) value of the yield percentage deviations being included as an additional explanatory variable to account for the "cumulative" weather impact, yields an adjusted R^2 value of 0.73 and 0.87, respectively for the entire period 1952-81 and the earlier period 1952-66. A similar regression for 1970-81 (without the lagged value) still yields a $R^2 = 0.22$. (13) This clearly attests to the importance of the weather as a yield determinant.

More strikingly, a multiple regression of 1952-1981 grain yields (in kg/ha) on the absolute deviations of the weighted areas from the 27-year mean and the fertilizer (chemical and natural) inputs (in kg/ha) yields an adjusted $R^2 = 0.98$. In other words, nearly all the year-to-year grain yield changes from 1952-1981 in China can be explained by the weather variability and the application of fertilizers which, especially chemical fertilizers, represent in many ways the most composite indicator of modern technologies.

From Figure 2 it is also clear that grain yield fluctuations have been increasingly stabilized from the periods 1952-1966 to 1970-1981. If we use the familiar Coppock's method of measuring international trade instability, then the grain yield instability index for China has markedly declined from 7.18 in the earlier period to 2.19 in the later period, although the corresponding disaster-area instability index has shown only marginal improvement from 32.9 to 29.9. (14) Evidently, the massive Chinese investment made in the past three decades or so especially in the form of labour accumulation to establish the "high-and-stable yield fields" have paid off rather handsomely.

The Technological Yield-stabilizers

The technological factors which have contributed to increasing and stabilizing grain yields are numerous. The familiar ones include (1) expanded and improved irrigation and drainage, (2) increased application of chemical fertilizers and pesticides, (3) breeding of fertilizer-responsive high-yield seed hybrids, and flood or drought-resistant strains, and (4) better field preparation and management practices. Also significant has been the increase in the multiple-cropping index -- a subject to which I shall turn shortly.

Figures 3 and 4 show clearly the close relationship between yield increase and improved irrigation and application of chemical and organic fertilizers. Fifty-seven percent of the irrigated areas are now (1981) handled by power (mechanical and electrical)-driven equipment compared with 4% and 25% for 1957 and 1965 respectively. And the per hectare power input of this modern irrigation sector stands now at three horse-power, nearly trebling the 1965 level. If the given irrigated area figures could be properly weighted by the horse-power index, the correlation between grain yield and irrigation ration (Figure 3) would probably become much closer.

China's irrigation ratio is by no means small by Asian standards, as Table 1 shows.

Whether and to what extent it can further be expanded is a multifaceted question which cannot be easily answered. One Chinese source has estimated that the irrigated area could be

Figure 3. Trends in Irrigation Ratio and Grain Yield in China, 1952-1981.

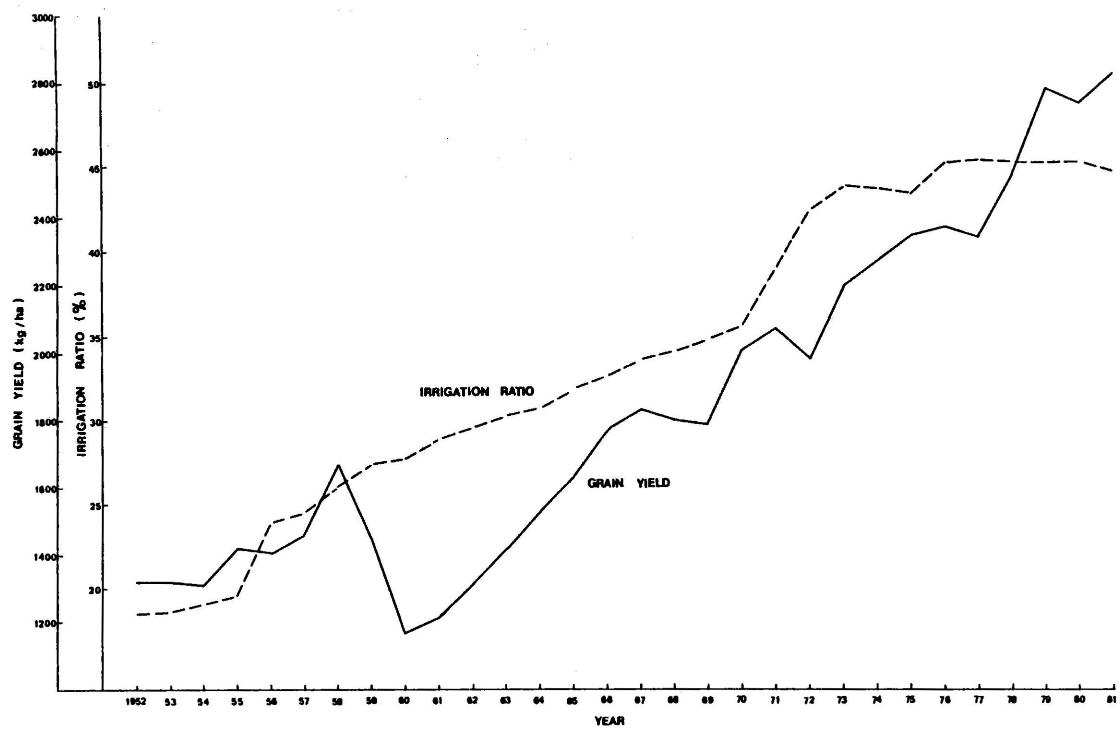


Figure 4. Relationship between the Application of Fertilizers and Grain Yield in China, 1952-1981.

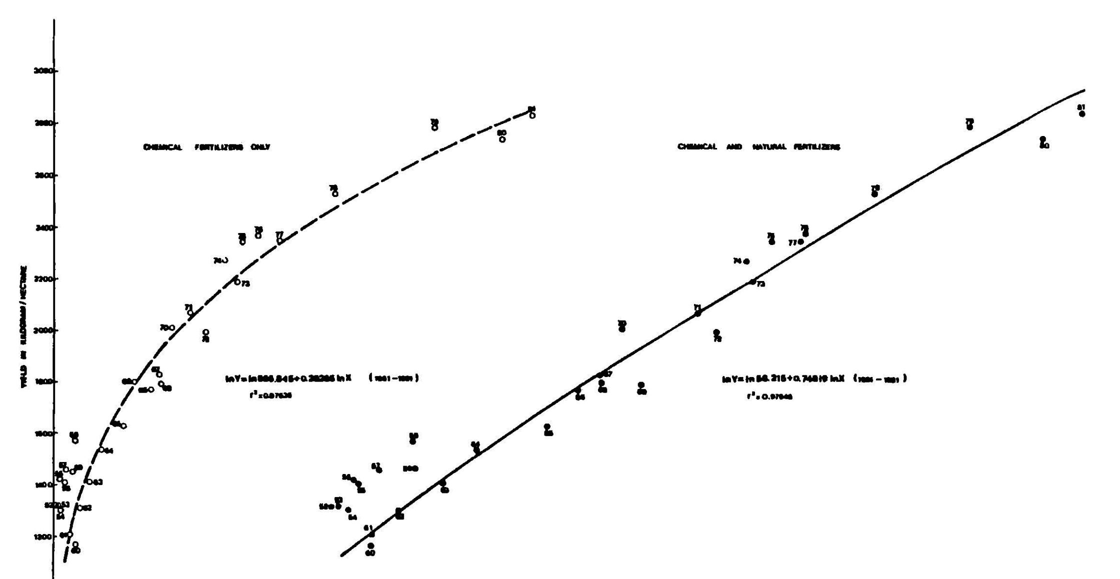


Table 1. Proportion of Arable Area Irrigated and Chemical Fertilizers Applied per Hectare in China and Selected Countries.

	Irrigation ratio (%)	Chemical Fertilizers (ka/ha)	
	1977/81 (1)	1970 (2)	1979/81 (3)
China	44.7	32	134
India	20.8	13	30
Pakistan	68.0	-	-
Japan	65.7	373	478
Korea	22.6	-	-
U.S.A.	9.2	81	111
Canada	1.1	18	41
Australia	-	22	29
Soviet Union	6.9	40	75
United Kingdom	1.4	260	323
France	3.0	-	-
W. Germany	-	400	479
Italy	-	90	189
World Total	13.5	-	-

Source: Various Chinese official sources and FAO as cited therein.

Note : Columns (1) and (3): Figures for China refers to 1981; others 1977 and 1979 respectively.

expanded to 53 million hectares (i.e. by 17.8%) simply by building more auxiliary works, including pumping and siphoning stations, to the larger establishments, and by improving the storage, conveyance and efficient use of presently available irrigation water(15).

Taking chemical fertilizers alone, their accelerated application in China seems to have resulted in diminishing yield return per hectare sown. Nevertheless, the performance of the "all-fertilizers series" (Figure 4) clearly implies that it amounts to nothing more than an accelerated "substitution" of chemical for natural fertilizers, in order to keep pace with the desired rate of yield increases. Specifically, in terms of total nutrient application per se (i.e. natural fertilizers included), the return to scale seems to have remained fairly constant over the years. Natural fertilizers in China make up indeed an integrated bulk of the total supplies. And their method of collection, storage and decomposition, especially with respect to night soil and animal manure, has also been increasingly modernized in the past decade.

By international comparison (Table 1) there seems still to be much room for expanded application of chemical fertilizers in China. It is difficult to determine when diminishing return will make further application uneconomical, because officially fixed output and input prices render market test for an optimal input level impossible or less meaningful.

The contribution of the scientific seed breeding has been relatively well documented(16), and need not detain us. The marked expansion in 1982 of areas sown with the high-yield rice hybrid represents probably the single most important factor accountable for the spectacular increase in China's paddy rice production last year, namely from 14.396 million tons in 1981 to 16.124 million tons in 1982 (17) -- although favourable weather condition was undoubtedly a rather significant contributory factor. The increase is nearly 1.5-fold of that of the world total, according to the latest FAO statistics(18).

The risk-aversion function of the multiple-cropping system is also noteworthy, although rarely has it been considered in studies of Chinese agriculture. That is, since drought or flood frequently lasts for only one cropping season, or even shorter, the planting of two crops enables an early crop failure to be offset by a later successful harvest. Such a stabilizing effect should be apparent from consideration of the yield per hectare of the <u>arable</u> area(19). In terms of sown area, while the second or the third crop with their normally lower yields may slow down the growth of the average yield over time(20), an increase in the multiple-cropping index, especially when, as in China, arable land is being reduced, may facilitate a broader dispersal of yield-loss risks.

It is not possible to quantify the relative stability contribution of the multiple-cropping system. But the multiple-cropping index of the grain-cultivated area has increased

steadily by around 16% from the early 1960s to the late 1970s, and the marked increase for the rice area, from an average of 123.6 in 1952-57 to 171.0 in 1976, (21) is particularly noteworthy bearing in mind that rice contributes almost half of national grain production.

<u>The Socio-economic Factors</u>

Technological progress aside, there are important socio-economic factors which act as important yield-stabilizers. Specifically the availability of an enormous rural population makes possible the adoption of the most labour-intensive "gardening" techniques used throughout China in grain cultivation, and especially facilitates protection against droughts and floods(22). This is undoubtedly one of the most spectacular aspects of China's agriculture. In addition, the strong subsistence urge noted earlier, together with the strictly imposed farm surplus siphoning system to ensure stable supplies for the benefit of forced-draft industrialization, make the "gardening" techniques desirable. In contrast, in the U.S. and the Soviet Union (where the per capita grain availability in 1981 was more than twice that of China), the absence of such subsistence pressure means that the real opportunity costs involved could not warrant adopting the massive Chinese approach to cope with weather adversities.

These unique Chinese elements give the Chinese economy all the essential features of a Naturalwirtschaft. Taken together, they underline our finding that the multiple regression of grain yield trend on fertilizer inputs and weather impact proves to be a considerably better fit (R^2 = 0.98) than the results suggested by McQuigg (R^2 = 0.85 to 0.90) for the U.S. Evidently, within the fully monetized and marketized U.S. context, grain production and input decisions (whether or not to push onto the set-aside acreage, for example) are also subject to changes in relative prices and the government's stockpile policy, as well as other factors.

Recent Changes in Agricultural Policy

I shall now turn to the problems of how changes in agricultural policy since 1978/79 tend to affect the various technological inputs and the socio-economic parameters of grain production in China; and how weather variability may bear on the entire input-output constellation.

The major aspects of the policy changes have now become familiar and can be summarized as follows. First, in an unprecedented attempt to correct the industrial-agricultural "price-scissor" in favour of the farm sector, state procurement prices for 18 different kinds of farm products have been substantially raised since the summer harvest of 1979. For the compulsory grain delivery quotas the increases amounted to 20%, with a price premium of 50% for above-quota sales. In the case of cotton, which is also subject to unified purchases, the respective increases were 15.2% and 30%. And purchase prices for

edible oil and pork were adjusted upward by nearly 25%. (23)

Moreover, prices for industrial sales to the rural areas, especially producer goods needed by agriculture, are generally to be kept constant or may even be gradually reduced. Agricultural taxes (mostly in kind) have been lowered or exempted altogether for many poorer localities. The same applies to income taxes imposed on rural industries and other non-farm enterprises. In addition, the National Agricultural Bank was reinstated in 1979 to facilitate rural credit supplies for production and investment.

The second major aspect of the reform which is equally, if not more spectacular, is that the established practice of collective farming has now been widely replaced by the so-called responsibility farm system. This constitutes in effect a quasi-reprivatization of the farmland under which the state (through the collectives), collects a fixed land rental (in kind) in the form of a contracted output quota. Anything produced in excess of the quotas is completely accruable to the contracting peasant households. Under this "Baogan Daohu" system, draft animals and small and medium-size farm implements have also been reconverted into private possession through either direct title transfers or conditionl assignments(24).

The collectives are, however, still in control of the large farm machinery and irrigation and other public facilities(25) in addition to seed breeding. The collateral arrangement for this "two-tier ownership" is that the output contract covers not only the predetermined amount of state procurements, but also the planned collective retentions for productive reinvestments, in addition to the necessary grain reserves and the collective welfare expenditure(26).

Also, beginning in 1982 the same state procurement prices have been applied to sales by the individual peasant families under the "Baogan" responsibility system, on contrast to the previous practice adopted by the collective of using a lower set of internal clearing prices(27). This enables the income benefits from the decreed price increases to be filtered more directly to the household level.

In a way, indeed, the entire "desocialization" process seems to have been prompted by the need to make the concerted price incentives more effective. Specifically, if the former more egalitarian collective-distributive structure had remained unchanged, the price increases might simply have amounted to a once-for-all price subvention. By contrast, the Baogan system has made income distribution more closely related to the relative marginal contribution(28).

The third aspect of this integrated reform package reflects the need to promote rural economic diversification, in order to (1) absorb labour made redundant by the more efficient Baogar system, and (2) produce more non-farm consumables and so ease local demand pressures on the urban light industries. As a result, family or organized sideline production is now greatly

encouraged, as are the rural trade fairs which serve as the natural outlets for subsidiary outputs.

The fourth integral aspect can be seen in the decentralization of agricultural planning and control. The number of planning product categories and obligatory targets were reduced from 21 and 31 respectively in 1978; to 16 and 20 in 1981; and further to only 13 categories in 1982. (29) In many localities the state crop acreage targets were ignored or abolished altogether by the local authorities.

The final, but not least important, aspect is that decision-making on agricultural investment has been substantially decentralized. Thus, Table 2 shows that centralized state investment has declined in recent years in both absolute and relative terms.

The same applies to total state budget expenditure on the entire farm sector. The trends are in fact quite contrary to the original plans set in September 1979, to raise the shares of state investment and budget expenditure for the agricultural sector up to 18% and 8% respectively "within the forthcoming three to five years"(30). It is clear that in preference to direct state investment, the new policy seeks to transfer investment resources to the local sector by way of increasing farm purchase prices.

The Chinese reform package is obviously still too young to generate sufficient quantitative evidence which might be used to

Table 2. Share of Agricultural Sector in State Budget Expenditure and State Investment in China, 1952-1982.

	State Budget Expenditure		State Investment	
	Million yuan	as % of total	Million yuan	as % of total
1952	900	5.11	583	13.3
1957	2,460	8.09	1,187	8.6
1962	3,680	12.05	1,439	21.3
1965	5,500	11.79	2,497	14.6
1975	9,900	12.06	3,840	9.8
1979	9,010	7.07	5,792	11.6
1980	8,210	6.77	5,203	9.6
1981	7,368	6.76	2,921	6.8
1982	7,650	6.72	3,400	6.1

Source: Various Chinese official sources.

verify its full impact(31). This is especially so of the Baogan responsibility system: although that system now covers some 80% of all production teams under the Chinese commune system, its full-fledged expansion only started from the end of 1981. Prior to that date the incentive policy measures were very much limited to the improvement of the various workpoint systems(32).

Nevertheless, the quantitative implication of the procurement price increases and the initial responses to the Baogan system do allow us to draw some tentative conclusions about the possible impact of the new policy on China's future agricultural performance.

Impact on Aggregate Savings

First, according to my incomplete estimate, price increases and various tax concessions have for the entire 4-year period 1979-1982 added not less than 76,000 million yuan to the gross revenue of the rural sector(33). This amounts to 66% of the total state budget expenditure for 1982, and has served to change very markedly the intersectoral distribution of national income. Note the consistent reversal of agriculture's share since 1979 as revealed in Table 3.

The incremental income share by agriculture is certainly more than sufficient to offset the marginal reduction in state investments shown in Table 2. Its distribution between consumption and investment is of course a problem of a different order. But if the survey estimates shown in Table 3 are a

Table 3. Trends in Sectoral Distribution of Gross Domestic Product and Peasants' Disposal Income and Consumption Expenditure in China, 1952-1981 (at Current Prices).

	Gross Domestic Product							Peasant Income (Y) and Consumption Expenditure (C) in Yuan/Person		
	in 100 million yuan			percentage share						
	A	I	S	A	I	S		Y	C	C/Y
1952	340	136	113	57.7	23.1	19.2	1978	133.57	116.06	0.87
1957	425	302	181	46.8	33.3	20.2	1979	160.17	134.51	0.84
1962	444	335	145	48.0	36.3	15.7	1980	191.33	162.21	0.85
1965	641	558	188	46.2	40.2	13.6	1981	223.44	190.81	0.85
1978	1,065	2,091	412	35.4	50.9	13.7	Increases			
1979	1,318	1,666	366	39.3	49.8	10.9	1979/78	26.60	18.45	0.69
1980	1,466	1,848	353	40.0	50.4	9.6	1980/79	31.16	27.70	0.89
1981	1,634	1,871	382	42.0	48.1	9.9	1981/80	32.11	28.60	0.89
							1981/78	89.87	74.75	0.83

Source: Various Chinese official sources.

Note : A = Agriculture, I = Industry and Construction, and S = Transportation and Trade.

reliable indicator, the average marginal propensity to save of peasant families amounted to around 17% for 1978 to 1981. The overall farm sector's saving ratio is of course substantially higher, if "corporate savings" at the production team level and by the nonfarm rural enterprises are included. Indeed, the recently released Sixth Five-Year Plan 1980-1985 has envisaged an overall marginal propensity to save of 39% for peasants as a whole(34). This is extremely impressive considering the potentially high income elasticity of the subsistant Chinese farmers.

Changing Investment Priorities

Perhaps more important than the size of aggregate savings is the question of how they are reinvested. The new policy tends to disfavour larger rural overhead capital construction for a number of reasons. First of all, as already noted, centralized state investment allocations normally designated for large water conservancy projects embracing several xian (county), diqu (prefecture) or provinces have now been curtailed. The responsibility farm system also inhibits the large-scale labour mobilization for irrigation projects that has been so characteristic of the Chinese approach in the past -- indeed often made without any quid pro quo for the collectives or the individual peasants concerned(35). In order not to further impair peasant incentives, the new approach, which I have called the Bazhong model elsewhere(36), stresses voluntary participation with strict adherence to the principle of mutual cost-benefit clearance between the state and the collectives and their members, and among the collectives involved. This has undoubtedly made the financial costs of "labour accumulation" prohibitive, especially when set against the attractive competitive earning available under the Baogan system and the current policy drive for rural economic diversification.

A related phenomenon has been the rapid proliferation of the "new five small industries" (cotton spinning, knitting, sugar-refining, cigarette and wine-making) to partially replace the familiar old "five smalls", namely, cement, chemical fertilizers, farm-machinery, metal-making, and energy (e.g. small coal mines). The "old five smalls," often founded by the xian or the commune leaderships by extorting the accumulations of the production brigades and teams, effectively amounted to an integrated local system of small-scale heavy industries to supply agriculture with the necessary producer goods(37). Their reduced importance (excepting perhaps chemical fertilizer plants) reflects the declining demand for such heavy construction materials as cement and iron and steel bars needed by irrigation overhead projects. But more importantly it has been caused by the enormous effort made at the local level in recent years to shift investible resources to the new five small industries, which have bcome much more lucrative as a result of mounting income-induced demand for related light consumables. (More will be said about this shortly.)

There is in fact widespread concern that farm investments will suffer under the new agricultural policy. Nevertheless, the dwindling large-scale overhead constructions seem to have been matched by increased investment in small and medium-sized farm implements which are more suitable for small-scale operation(38). These include hoes, sickles, night-soil buckets, animal-driven ploughs, carts, and other semi-mechanized farm implements such as threshing machines. It is unlikely, however, that the number of large tractors, harvesting machine, heavy transport vehicles, and irrigation and drainage equipment will experience "any substantial increases within a certain period to come"(39). The same may of course be said of the construction of large irrigation canals and reservoirs.

Like the accelerated increase in the use of chemical fertilizers, the new investment emphasis is clearly aimed at quicker shortrun returns. Coupled with the greatly improved incentives, the initial effect seems to have been enormous, judging from the impressive 8.7% increase in grain production from 1981 to 1982, (40) even ignoring the favourable weather conditions.

It is difficult to assess, however, the possible longer-term productivity impact of the shifting intra-rural investment priorities. Perhaps with nearly half of the country's arable land now under irrigation and around a quarter classified as "the high-and-stable yield fields" (free of the impact of droughts and floods)(41), the Chinese leadership feels that the time is ripe for the introduction of some fundamental changes. Or, should the policy changes be considered as merely interim measures designed to compromise the interest of the long hard-pressed Chinese peasants and prepare for another big-push in rural investment under persistent austerity conditions?

Trends in Extension Services

Many western scholars have argued that agricultural extension services are an important key to the widespread and efficient use of modern inputs(42). Yet Table 4 shows that the scale of such operation has apparently been markedly reduced in recent years.

It is not yet clear whether this represents a consolidation or a real retrenchment caused by the reduced role of the collectives. Nevertheless, the effect could be a serious one in view of the significant past contribution of extension services in China. For example, from 1976-1981, around 90% of the cumulative increase in rice output in China was said to be accountable by the expansion of the acreage sown to the new hybrids -- these now covering 66% of the rice acreage total(43).

Problems of Production Instability

Let me turn to the new policy impact on current production. The observed decentralization in agricultural planning and control coupled with the diversification drive tends to make the rural output composition much more sensitive to relative price

Table 4. Agricultural Extension Services in China, 1950-1981 (No. of Stations/Farms)

	Agricultural technical services	Animal breeding	Vetinary treatment	Seed breeding	High-yield strains demonstration farms
1950	10	148	251	-	-
1952	232	389	1,005	-	-
1957	13,669	821	2,930	1,390	1,899
1979	17,622	1,174	8,495	2,369	2,418
1980	15,114	533	5,530	2,436	2,404
1981	15,415	566	6,778	2,370	2,392

Source: Various Chinese official sources.

changes. Thus, sown acreage for cotton, tobacco leaves, and other lucrative cash crops have been greatly expanded in many localities, in order to feed the flourishing new five small industries(44). As a result, the national grain acreage has been consistently reduced by 5% from the 1978 level of 121 million hectares (by no means a high record) to the lowest recorded level of 115 million hectare in 1981. (45) In mid 1981 the situation was serious enough to prompt the central leadership to issue a blanket administrative order to close down or suspend the operation of the small factories, notably for cotton spinning and cigarette-making(46). The planned crop-acreage targets which in many areas had been earlier abolished were also reimposed or strengthened(47).

There is also widespread fear that the Baogan responsibility system may prove to be vulnerable to fluctuations in weather conditions. Setting aside the long-term implications of reduced investments in drought and flood-resistant capacity, with the rural context now being increasingly marketized and monetized, price-cost considerations as noted earlier may very well exert a destabilizing force in grain production, especially in the well or better-off areas.

It is not exactly clear how the poorer localities would fare. Some reports have indicated that in the absence of the mass approach which was most in evidence during the Cultural Revolution period, Baogan peasants have also been highly motivated to ward off weather adversities(48). This could be

explained in terms of the spontaneous subsistence urge mentioned earlier. But equally strong administrative fiat also seems to be at work. In one locality, for example, it has been stipulated by the local Party Committee that failure to fulfill the contracted deliveries to the state and the collective will result in the Baogan right being revoked, together with the assigned private plot. The peasant family concerned may be denied ration coupons for chemical fertilizers and loan facilities next year. Worse still, any amount of grain sold to the family to make ends meet in the current year is to be returned as well(49).

It is difficult to assess the net aggregate impact in this respect. Although my agricultural weather index suggests that weather conditions in recent years (especially 1978 and 1980/81) were almost as bad as in 1960/61, the very recent adoption of the Baogan System and other associated agricultural policy and organizational changes made an assessment premature. Nevertheless, as a substitute socio-economic type of stabilizer, the coercive measures just described may, possible scale effect aside, be a no less powerful instrument than the conventional collective approach.

<u>Procurement and Supply</u>

Under the Baogan System the state compulsory procurement quotas must obviously be kept at such a low level to ensure that the income available to the contracting family from output produced in excess of the contracted amount is basically comparable to the earning potentials of other available economic opportunities. Nevertheless, it does not necessarily imply a reduced state procurement. In fact, in the past few years, the peasants seem to have eagerly responded to the attractive price premium for both the above-quota and the "negotiated" sales(50). As a result, the declining total state procurement ratio as revealed in Table 5 for the past three decades has been markedly reversed in recent years, with the absolute magnitude rising at a rate much more quickly than the total grain output(51).

Generally speaking, such an increase in total state procurement ratio implies not only a more elastic grain production, but also a more secure local supply. Even more remarkably, this has occurred despite the poor weather of 1980 and 1981. It cannot yet be established, however, whether under similar large-scale weather adversities the Baogan System will respond in the same manner. This question apart, one may perhaps suppose that inter-regional grain transfers in China can now proceed in a more secure manner in favour of the grain-deficit area. But if correct, why is it that China's grain imports have continued to rise, especially in the most recent years?

China's Import Requirements and World Grain Trade Instability, 1980-2000

To discuss the possible impact of weather and domestic production variability on China's grain trade with the outside world it is necessary to first examine its present level of grain

Table 5. State Grain Procurements as a Percentage of Total Grain Production in China, 1952-1982

First Decade		Second Decade		Third Decade	
Year	%	Year	%	Year	%
1952	23.81	1962	20.26	1972	16.03
1953	25.80	1963	21.76	1973	18.27
1954	30.02	1964	21.41	1974	17.03
1955	25.85	1965	20.16	1975	18.49
1956	20.87	1966	19.36	1976	17.17
1957	23.57	1967	19.00	1977	16.86
1958	25.92	1968	19.33	1978	16.65
1959	37.72	1969	18.23	1979	18.10
1960	32.43	1970	19.37	1980	19.12
1961	24.78	1971	17.52	1981	21.06
Average	26.87	Average	19.51	Average	17.96

Source: Various Chinese official sources.

Note : Grain procurements in China are measured in terms of "trade grain" (maoyiliang). The conversion rate between unhusked grain (unit used for total output statistics) and trade grain was approximately 86 percent in the 1950s (Walker, 1982, p.577). No conversion was made for this Table, however.

supply and the pattern of grain demand.

Table 6 shows that the per capita grain availability from domestic sources was restored by 1975 to the record level of 309 kilograms per head achieved in 1958 when China was a net grain exporter. Nevertheless, despite the continuous surge in per capita grain production since the mid 1970s, the net import ratio of per capita grain supply has increased abruptly since 1977, completely reversing the long-term declining trend discernible since the mid 1960s.

Obviously the reversal was not prompted by sheer subsistence requirement which as well-known was the single most important cause for the drastic import increases in the early 1960s. Judging by the improved overall food balance and the over-proportionate increases in total state procurements noted earlier, nor should the accelerated increase in net import ratio be attributed to "the retention of a growing share of grain in the rural areas"(52), and thus the necessity to purchase more grains to feed the deficit areas or areas which have become more specialized on cash crops production in line with the new government's policy(53).

The necessity to supply the major urban centres has also been cited as an important factor for China's increased grain imports(54). Hidden in this notion is the transportation cost argument. Specifically, inland transport bottle-necks make internal grain transfers from the surplus region, notably Sichuan province, appear more costly and less efficient than to rely on

Table 6. Per Capita Grain Availability in China from Domestic Sources and Trade, 1952-1982 (kilogram unhusked)

First Decade				Second Decade				Third Decade			
Year	Qd	S_t	Rm	Year	Qd	S_t	Rm	Year	Qd	S_t	Rm
1952	285	282	-1.06	1962	240	247	2.83	1972	277	279	0.72
1953	283	280	-1.07	1963	247	254	2.76	1973	298	302	1.33
1954	281	278	-1.08	1964	265	272	2.57	1974	304	308	1.30
1955	299	295	-1.36	1965	268	273	1.83	1975	309	309	0.00
1956	306	302	-1.33	1966	288	292	1.37	1976	306	307	0.33
1957	301	298	-1.01	1967	286	288	0.69	1977	299	305	1.97
1958	309	305	-1.31	1968	267	269	0.74	1978	318	325	2.15
1959	263	256	-2.73	1969	262	264	0.76	1979	342	353	3.12
1960	219	214	-2.34	1970	290	294	1.36	1980	326	338	3.55
1961	224	231	3.03	1971	295	295	0.00	1981	326	-	-
								1982	348	-	-

Source: Various Chinese official sources

Note : Qd = domestic output, S_t = total supply (Qd plus net import or minus net export), Rm = $(S_t - Qd)/S_t \cdot 100$; hence negative signs indicate net export.

For estimating the total of net imports/exports milled rice in China's exports were converted into unhusked equivalent by using FAO's standard of 65%.

shipments from abroad to feed the coastal metropolitans(55). However, grain deficits for Beijing, Tianjin, and Shanghai, the three metropolitans frequently referred to, amounted in 1981 to less than 15% of the total net national grain import for 1980. (56) Such a small amount of deficits undoubtedly can be easily absorbed by the neighbouring "grain-rich" provinces Hebei, Shangdong and Jiangsu(57).

It seems more appropriate to adhere to Mah's frame of reference and argue that the accelerated increases in grain imports in recent years were essentially prompted by requirements of indirect grain consumption over the subsistence level(58). Besides increased industrial uses (oil-pressing, brewing, etc.), demand for feed grains seems to be an important factor. Meat (pork, beef and mutton) production has been increased most drastically from 8.563 million tons in 1978 to 12.609 million tons in 1981 under the massive drive made in recent years for dietary improvement(59). If a grain-meat conversion ratio of 6:1 is applied, for example, the derived feed demand would indeed greatly outstrip the realized grain imports by 4 to 5 folds. This may explain for the sudden upsurge in the import of coarse grains since 1978, both in absolute terms and relative to the import of wheat(60). Most of the new livestock programs are located in and around the major urban centres(61). The peasants can now better afford to take care of their own meat supplies by making more intensive use of the returned private plot for raising pig and poultry. Thus, the increased grain shipments

seem to have been primarily destined to the major metropolitans. The background for this argument is of course dissimilar to the familiar grain-deficit version.

Along these lines of thinking, let me construct a hypothetical grain balance for China for the years to come to serve as a basis for discussing the possible impact of recent agricultural policy changes with special reference to the trade implications. Table 7 shows that China's net grain import requirement will range from 3.05 to 12.84 million tons in 1985, compared with 12.18 million tons in 1980. By the end of the decade it will become an increasingly important net exporter.

The projection hinges on a number of crucial factors and assumptions. The most crucial factor is the population growth rate. The population targets imply indeed a natural increase rate of 1.53% for 1980-1985, 1.20% for 1985-1990, and 0.65% for 1990-2000. This is the arithmatics of the well-publicized one-family-one-child programme which seems to have already met with considerable social anathema. Birth control can perhaps be more easily executed in the urban centres which take up around 13% of the total population. In the rural areas, however, there seems to be widespread concern among the Party cadres that the Baogan system will render economic sanction against unplanned births less effective(62). It is also a remote prospect for the familiar inverse income-population growth function to set in some time within this century; for per capita disposal income is bound

Table 7. Hypothetical Estimates of China's Food Balances for 1985, 1990, and 2000 (million tons of unhusked grain)

	1980	1982	1985	1990	2000
1. Total Domestic Production	320.56	353.43	360.00	425.00	544.00
2. Population (million)	982.55	1,015.41	1,060.00	1,125.00	1,200.00
3. Per Capita Availability (kg)	326.25	348.07	339.62	377.78	416.67
4. Direct Human Consumption (at 259 kg/head)	254.48	262.99	274.54	291.38	310.80
5. Waste (5.22% of Line 1)	16.73	18.45	18.79	22.19	28.40
6. Seed (4.26% of Line 1)	14.80	16.33	16.63	19.63	25.13
7. Feed (11.69% of Line 1)	37.47	41.32	42.08	49.68	63.59
8. Industrial Use (2.89% of Line 1)	9.26	10.21	10.41	12.28	15.72
9. Total Indirect Consumption/Waste					
(A) by Klatt: Line 5-8 (24.41% of Line 1)	78.26	86.31	87.91	103.91	132.84
(B) by Liu-Yeh (21.7% of Line 1)	-	76.69	78.12	92.23	118.05
10. Additional Feed Requirement	0.00	4.55	10.39	26.19	81.28
11. Total Utilization					
(A) Lines 4, 9(A) & 10	332.74	353.85	372.84	421.35	524.92
(B) Lines 4, 9(B) & 10	-	344.23	363.05	409.80	510.13
12. Net Import Requirement					
(A) Line 11(A) minus 1	12.18	0.42	12.84	-3.65	-19.08
(B) Line 11(B) minus 1	-	-9.20	3.05	-15.20	-33.87

Source: Various Chinese official sources, unless otherwise noted below.

Note : Line 1 : 1980 and 1982: realized output.
1985: target set in the Sixth Five-Year plan 1981-85.
1990: target given by Chinese officials to the Agricultural Economics and Statistics Delegation of the US Department of Agriculture in October 1980. See Surls and Tuan, p. 437.
2000: assumed 2.5% growth per year from 1990.

Lines 4-8 : per capita direct consumption and conversion rates for waste/indirect grain consumption are adopted from Klatt (1983). The per capita direct consumption figure is also agreeable with Walker's (1982) reconstruction of the Chinese estimates.

Line 9(B) : Liu and Yeh (as cited in Mah (1971), p.123) estimated the nonfood uses for 1952-57 to be 16.3% to 21.7%. The upper percentage is used here.

Line 10 : A grain-meat conversion rate of 6:1 was first applied to the projected amount of meat production (Table 7) in excess of the 1980 output level. From the derived total the targeted feed requirement in line 7 in excess of the 1980 amount of 37.47 million tons is then subtracted.

to remain low with its growth being constrained by the established economic strategy of maximizing capital accumulation for speeding up industrialization. It is obviously beyond the scope of this paper to say more about the population problems.

The grain production targets as given are less ambiguous. The planned compound growth rate is 2.94% per year for 1980-1990, and 2.50% for 1990-2000. This is only marginally greater than the long-term 1952-1981 record of 2.4% per year (or 2.6% for 1952-1982). The improved yield stability since the early 1970s as shown in Figure 2 tends to make it easier for China to achieve the planned grain tragets. If the decadal weather pattern as observed for the past thirty years is of any indication, then the exceptionally good weather of 1982 following two bad years may signal the advent of a decade of favourable weather. This may make the relatively high growth target of 2.94% per year for 1980-1990 appear less ambitious.

A number of important technical and policy parameters of grain production should be mentioned. First of all, as revealed in Figure 4, there seems still substantial room for increased application of chemical fertilizers before serious diminishing return to scale will make it uneconomical. Perhaps more important is the fact that under the established policy framework, grain production and agricultural growth in general will remain a constrained one as noted earlier. This means that a relatively small degree of relaxation in terms of the controlled overall inputs package may considerably speed up the pace of grain production as evidenced by the case of the recent past.

Certainly the impressive increases in grain production by 3.77% per year from 1978-1982 (despite bad weather in 1980/81) should not be used in an unqualified fashion for projecting the future trends. For one thing, the initial incentive effect may soon level off. Then there is the question of how far the multiple-cropping index can be expanded further given the persistent competition from the industry and housing sectors for scarce arable land. The long-term productivity implications of reduced over-head investment and possibly agricultural extension services may have to be considered as well; apart from diminished scale economies attributable to the "desocialization" process. Taking into account these mitigating factors what all we can say is that the projected grain production targets do not seem to be disproportionate to the past performance.

To turn to the short-term consideration, the 1985 grain target of 360 million tons probably can be achieved or even overfulfilled with ease. The realized 1982 output is indeed only 1.8% short of this. The effective net import requirement will likely be lower than the upper bound of our estimate; and should be very substantially below the projection recently made by Kilpatrick, a CIA analyst. I shall turn to this point shortly.

Apart from the possible future size of population and grain production, the import projection depends decisively on the

assumptions made about direct and indirect human grain consumption. For all the target years a per capita direct grain consumption of 259 kilograms per year was assumed (Table 7). This is the estimated value for 1980/81 and appears to be adequate. The allowance, also made by Klatt in March 1983, for waste, seed, feed (line 7 alone) and industrial use amounts to a total of 24.4%. This is quite generous even compared with the more liberal estimates made by some Chinese scholars including the Liu-Yeh ratio as given in Table 7. (63)

The grain-meat conversion rate of 6 to 1 underlying the estimate of the "additional" feed demand (line 10) is adopted from a similar projection made by Kilpatrick(64). It is 20% greater than the one used by another American authority reporting on China after his visit there. A Chinese source used a 4:1 ratio for pork which clearly will continue to dominate future meat production in China(65). Moreover, it is also assumed that "non-grain sources of feed (including barbage, vegetable residues and water plants) have become nearly fully utilized"(66), and are thus no longer available for any amount of livestock needed to meet the additional future meat requirement of the population.

The "additional" feed requirement assumes great importance in our food balance projection. It is in turn based on the projection of future consumer demand for meat which should be briefly noted here. Table 8 gives the projection for both total meat production and per capita consumption which covers, namely, pork, beef and mutton only.

Table 8. Meat Production Targets and Projected Income (Expenditure) Elasticities of Demand for Meat in China, 1985, 1990 and 2000

	Realized		Targets			Compound Growth percent per year		
	1980	1982	1985	1990	2000	1980-85	1985-98	1990-2000
1. Meat Production (million ton)	12.1	13.5	14.6	18.5	30.0	3.83	4.85	4.92
2. Kilogram/head	12.3	13.3	13.8	16.4	25.0	2.32	3.51	4.31
3. Total Expenditure (Yuan/head)	227	-	277	n.a.	n.a.	4.06	-	-
Elasticity (Lines 2/3)						0.57		
4. Urban Expenditure (Yuan/head)	468	-	547	n.a.	n.a.	3.17	-	-
Elasticity (Lines 2/4)						0.73		
5. Rural Expenditure (Yuan/head)	173	-	212	n.a.	n.a.	4.15	-	-
Elasticity (Lines 2/5)						0.56		
6. Peasant Income (Yuan/head)	191	-	255	n.a.	n.a.	5.95	-	-
Elasticity (Lines 2/6)						0.39		

Source: Various Chinese official sources.

Note : Meat production covers pork, beef and mutton only.

Expenditure and peasant income are survey estimates made by the State Statistical Bureau.

The per capita meat consumption target for 1985 seems to be consistent with the planned increase in consumption expenditure, especially that of the urban population, judging by the fact that the derived income elasticity of demand (0.72) is basically agreeable with those observed in Taiwan, Hong Kong, and Singapore, all dominated by Chinese inhabitants(67). If correct, then it tends to reinforce the argument that the new livestock programs are predominantly urban-based. It is indeed not unlikely that peasant demand for meat is left out of the supply targets for reasons mentioned earlier.

Overall, by using Klatt's generous allowance ratios, the projected indirect grain consumption seems to have contained a considerable margin on top of the buffer built in with the assumption of the 6:1 grain to meat conversion ratio. Certainly, the margins could be easily eaten up, should the bold birth control program fail seriously. But also note that direct grain consumption may be gradually substituted by increased meat consumption -- a point not considered in our food balance projection.

Bearing in mind such possible deviations and offsetting factors, it seems safe to argue that by the end of the present decade China will become a net grain exporter. The projected net exports of 3.65 to 15.20 million tons for 1990 and 19.08 to 33.87 million tons for 2000 represent namely 0.86% to 3.58% and 3.51% to 6.23% of the respective grain output targets. If the upper bound percentages are considered, China's relative size of net exports by 1990 will be comparable to that of her present net imports. And by 2000, it could be twice as much.

For 1985 my projected net import requirement of 3.65 to 12.84 million tons is substantially lower than Kilpatrick's estimate of 23 to 37 million tons. More seriously, the discrepancy widens for 1990 with my net export projection contrasting his projection of an enlarged net import requirement of 32 to 60 million tons(68).

The difference is mainly accountable by Kilpatrick's using a much higher allowance rate, namely 30% for "seed and other losses including waste and transport losses" in addition to a higher per capita grain requirement of 342.86 kilograms (unhusked) for both direct and indirect consumption(69).

Whether the projected import requirement will be effectively translated into import demand is of course a rather different matter. There is a host of intervening factors including foreign exchange availability, world supply situation and market price fluctuations, changing domestic policy attitudes toward grain import, and international political relations, etc. Based on similar considerations, a specialist from the US Department of Commerce has recently forecasted "a substantially slower pace (of increase) than 53 percent average annual rate registered in 1977-80". (70)

Frederic Surls, a US Department of Agriculture analyst, concluded that due to both lessened necessity for the Chinese

government's resale of grains to rural areas specializing in cash crops production and a slower growth of income in the urban/industrial sector, "for the next several years no significant upward trend in grain imports will occur"(71). The nature of these two latter forecasts is dissimilar to my food balance projection. I would rather predict a diminishing Chinese reliance, in absolute terms, on the world food market in the near future, especially in view of the exceptionally good harvest of 1982.

A lessened reliance on grain supplies from outside does not, however, necessarily imply a reduced Chinese role in the international grain trade. China needs hard foreign currency for import of heavy producer goods to support its industrialization programs. Given the prevalent rice-wheat price disparities (roughly 1:0.53 in 1981), (72) it seems likely that the present wheat (import)-rice (export) substitution process will continue for many years to come. Note that domestic grain consumption mix in China is strictly controlled; despite increased preference for such fine grain as rice. With wheat production continuing to grow much faster ahead of rice(73) following improved irrigation and increased application of chemical fertilizers in the North China Plain since the early 1970s, there may indeed come to an enhanced substitution of wheat for rice consumption among traditional rice-eating population(74).

Let me now turn to discuss the possible Chinese impact on world grain trade stability. The question simply arises from

China's dominant share in the world total of wheat import and rice export. Surls suggests a continuation of China's import instability, stemming from annual fluctuation in the supply of and demand for government grains rather than from frequent policy shifts. His remarks are worth quoted in length:

> "The Chinese government now has a stronger commitment to maintaining and raising standards of living than was the case in the past. Because of this, the government now seems less likely to pressure rural areas for grain supplies in years of poor harvest. It is also less likely to permit procurement shortfalls to be completely absorbed by lower consumption in the urban/industrial sector or reduced resales to rural areas. In addition, growing reliance on a limited number of commercial grain bases for government grain supplies may mean an increasingly narrow geographical base for these supplies and a resulting rise in the annual variability of supplies."(75)

Surls concluded that "with greater pressure to support consumption levels, an increase in the variability of supplies of government grains, and continued unwillingness to permit retail prices of basic food items such as grain to fluctuate, China's requirements of imported grain could show significant instability during the eighties. This would be a destablizing factor for world market grain prices."(76)

Setting aside the question concerning the newly emerging 50 commercial grain xian (county) bases which amount, in my view, to nothing but an embryonic concept for a large-scale regional agricultural specialization in some distant future(77); Surls' points boil down to the question about the possible impact of annual weather variability on grain production and procurement in China. The answer depends of course very much on the structure and level of the projected food balance.

Let us ignore the possible implications of our decadal weather pattern for the 1980s. Assume an abrupt downturn in grain production identical in scale (i.e. by 3.48%) to that from the bumper harvest in 1979 to the near-disaster in 1980. Assume also a zero shock-absorption capacity in our food balance system (Table 7). Then as shown in Table 9, a crop failure in China in 1985 or 1990 at the specified scale could still exert a considerable destablizing force in the world grain market. This is at least indicated by the fact that the implied growth rates of the Chinese net import requirements from 1980 to the target years, especially 1985, tend to substantially exceed any long-term record in world food trade.

Impressive as they are, the implied growth rates are, however, still consistently lower than the comparable records of China's net grain imports for 1975-1980 or 1970-1980, for example. If the increased built-in flexibility of the projected food balances is also considered, the effective import demand in the case of such a weather disturbance will certainly prove to be even lower. Besides, our crude estimates also show a declining trend in China's import dependency ratio in the future.

Nevertheless, to the extent that grain import requirements are built into the Chinese good balance, weather variability in China will tend to affect world grain market at a certain degree.

Table 9. Impact of a Hypothetical Weather Disturbance Similar in Scale to that of 1980 on China's Import Requirement in 1985 and 1990 (million tons)

		1985		1990
Grain Production Target (Table 6)		360		425
Previous year's output assumed realized(1):	360/1.0235 = 352		425/1.0338 = 411	
Minus weather - caused grain losses(2):	352x0.0348 = 12		411x0.0348 = 14	
Effective Output		340		397
Total Production Shortfall		20		28
Adjusted Import Requirement				
	(A): 20 + 13 from Line 12(A), Table 6	33	(A): 28 - 4 from Line 12(A), Table 6	24
	(B): 20 + 3 from Line 12(B), Table 6	23	(B): 28 - 15 from Line 12(B), Table 6	13
	(C): Average of (A) and (B)	28	(C): Average of (A) and (B)	19
Compound growth percent per year from 1980 (Table 6)				
	(A)	22.1		7.0
	(B)	13.6		0.6
	(C)	18.1		4.5

Note: (1) The compound growth rates (percent per year) from 1980-1985 and 1985-1990 (as from Table 6, Line 1) were used to determine the output in 1984 and 1989 respectively.

(2) Grain output in 1980 was 320.56 million tons, down by 3.48% from the bumper harvest of 332.12 million tons for 1979.

A simple regression equation fitted with China's net import values (lagged by one year) as the dependent variable against my agricultural weather index (in terms of absolute deviations of natural-disaster-covered area from the long-term mean) yields for the entire period 1952-1981 a r^2 value of 0.30. But interestingly, the positive association between net imports and weather anomalies turns out to be much closer for 1970-1981 (r^2 = 0.56) than for 1952-1966 (r^2 = 0.32). Evidently, the Chinese food balance and its entire economy are more closely integrated with the world markets since 1970 than in the earlier period. It will probably remain so for the years to come, although a full integration by way of her subjugating to the law of comparative advantages in international trade remains remote.

Thus far, we have looked at the Chinese import requirement solely from the food balance perspective. Whether or not the new agricultural policy will call for further problems of internal reallocation is a matter of a different order. Specifically, I shall now turn to the problems associated with state procurements of grains which seem to be Surls' focal point as quoted earlier. I would rather argue that with the projected increases in average per capita grain availability (Table 6) and the new price incentives provided state procurement pressures will ease gradually throughout the 1980s and thereafter; barring perhaps exceptionally bad crop failure as the one hypothesized above. The hectic response of the peasants to take advantage of the price premium for the above-quota sales and "negotiated" sales offered since 1979 seems to bear out the point made here.

Financial implications for the state budget aside, the price premium and the new siphoning instrument of "sales at negotiated (market) prices" all suggest greater procurement flexibility. With this in mind, one may even argue that by the second half or the end of the 1980s China may increasingly act as a stabilizing factor in the world grain markets, inasmuch as she is interested in reaping hard foreign currency by selling at high prices caused by shortfall elsewhere in the world; or by postponing imports until the world prices have become lower.

Nevertheless, in view of China's substantial share in world grain trade, any monopolistic market behaviour may also potentially disturb world market equilibrium in the future. Besides, a more elastic domestic grain supply may give China greater "leeway" in coping with imponderables non-commercial or non-economic in nature, and thus add to world trade instability.

Summary and Conclusion

In the past three decades grain production in China has become increasingly less vulnerable to large-scale weather anomalies due to continuous investment in irrigation and drainage, and in farm mechanization in general. Grain yield instability has declined from an average of 7.18 for the period 1952-1966 to 2.19 in 1970-81, measured on the familiar Coppock's trade instability index; although the degree of weather variability as captured in our quantitative agricultural weather

index has shown very marginal improvement only.

Scientific breakthroughs in seed breeding and increased application of chemical fertilizers have raised grain yield by 114% from a per hectare yield of 1,320 kilograms in 1952 to 2,828 kilograms in 1981. This occurred despite the fact that input supplies to the agricultural sector have been deliberately controlled under the established economic development strategy which favours maximizing capital accumulation for concentrated investment in the heavy-industrial sector; and that scarce arable area has gradually been curtailed in order to accommodate the needs of industry and housing.

Grain production has increased at an average annual rate of 2.6% from 1952 to 1982, ahead of the population growth rate of 1.9%. Per capita grain production stands at 348 kilograms in 1982 compared with 285 kilograms in 1952. The present level allows for a meagre margin for indirect grain consumption in China over and above the subsistence requirements, compared with advanced western countries.

China has become a net grain importer ever since 1961. The net import ratio of the per capita grain availability has steadily declined however, from the height of 3% in 1961 to less than half a percent in 1976. This declining trend was abruptly reversed in recent years (since 1977). Wtih 3.6% in 1980 the net import ratio has now become an all-time record.

Judging by the present level of per capita grain availability, it seems safe to argue that the accelerated increases in China's grain imports were not prompted by subsistence requirements. Nor are difficulties involved in state grain procurement following the decentralization in agricultural planning and control the main cause for this, as some western analysts tend to suggest. As a matter of fact, the ratio of state grain procurement to total grain output has in recent years markedly reversed the long-term declining trend, despite continuous (albeit erratic) upward surge in grain production. The enormous price incentives provided under the new agricultural policy seems to have worked considerably well, indeed.

A closer look at the food balances of the major urban centres, notably Beijing, Tianjin, and Shanghai, to which grain shipments from abroad are normally destined, reveals no serious supply deficits. For the three metropolitans cited the total deficits amounted in 1981 to less than 15% of the net grain imports in 1980.

The accelerated grain imports seem to have instead resulted frcm the Chinese government's new policy commitments to raising the urban living standards by allowing more indirect consumption of grain, notably in the form of meat and other grain-processed products. This accounts probably for the abrupt increases in coarse grain imports in recent years. If correct, this new consumption policy tends to make the Chinese domestic demands more integrated with the world market in the future.

Our projected food balances for China for 1985, 1990 and

2000 indicate declining import requirements. By 1990, if not earlier, China will be self-sufficient in grain requirements, indirect consumption included. The underlying assumption about the potential growth of grain production is underscored by the fact that nearly half of China's arable area is now under irrigation and that the present level of return to scale on the use of chemical fertilizers suggests room for further expansion.

It is not quite clear to what extent the current agricultural decentralization especially in the form of the Baogan responsibility system may upset the projected food balance. Larger-scale rural overhead investment suffers; but the decline is matched with improved peasant incentives for investing in small and medium-size farm implements. The use of chemical fertilizers has also increased rapidly, probably coupled with greater application efficiency, to reap the short-term benefits offered by the decreed increases in farm procurement prices.

However, the rural economic diversification drive tends to hinder the implementation of the compulsory grain delivery scheme, to the extent that the contracted output under the Baogan system must be kept at a level low enough that the income benefits to be derived from the overfulfilled output are comparable to other potential rural earning alternatives.

Institutional implication aside, weather variability may still exert considerable influence on the projected food balance, despite the declining long-term yield instability. A recurrence of natural calamities on a scale similar to that of 1980, for example, may bring about, in 1985 or 1990, an import requirement considerably higher than 11 million tons imported in 1980. Specifically, if we assume a zero shock-absorption capacity in the projected Chinese food balance system the hypothetical import requirement in both target years 1985 and 1990 would indeed be more than double the present volume and result in a net import ratio (of the respective projected grain production) of around 6% to 9% for 1985, and 4% to 7% for 1990.

Nevertheless, it seems unlikely that such requirements will be fully translated into effective import demand, in view of the rising per capita grain availability which will make the Chinese food balance structure increasingly flexible. Notwithstanding this, the possible international repercussion of such weather-bound large-scale import requirements as hypothesized for 1985 and 1990 would still appear to be less drastic than China's import fluctuations in the 1970s and early 1980s.

A regression analysis of China's net imports realized in the past, with our agricultural weather index serving as the explanatory variable reveals considerable influence of the annual weather variability. The correlation is quite pronounced (r^2 = 0.56) for the period 1970-1980, but not quite so for 1952-1966 (r^2 = 0.32). This reflects the interesting trend that with rising per capita grain availability the Chinese grain economy has become more integrated with the world grain market.

Relatively tight urban supply schedules in the 1970s might

have partly accounted for the above trend. But the more plausible explanation seems to be the government's increased policy commitments to a more diversified and richer pattern of urban grain consumption, especially in the late 1970s; rather than shortfalls in state procurements per se. If correct, then the observed correlation between annual weather variability and China's net grain imports may continue throughout the 1980s.

Our food balance projection shows that grain supply in China will eventually become self-sufficient by the end of the decade. This does not imply reduced Chinese importance in the world grain market, however. Given the continuous need to reap hard foreign currency to pay for imports of modern machines and equipment, the present wheat (import)-rice (export) substitution process may even be intensified to take advantage of the price disparities which at present stand roughly at 1:0.53.

With an increased per capita grain availability and internal procurement flexibility, China may better act as a stabilizing factor in the future world grain market, in as much as she is interested in exporting rice at high price caused by shortfalls elsewhere in the world, and by postponing wheat imports until world prices have become lower. However, the flexibility may also bring about monopolistic market behaviour in view of China's substantial share in world grain trade. Besides, it may provide her with greater leeway to cope with imponderables non-commercial and non-economic in nature, and thus add to world grain trade instability.

FOOTNOTES

1. Food and Agriculture Organization (FAO) of the United Nations (1982) Tables 9-11; and (1981) Tables 37 and 39. The 1982 rice figure is from FAO's Monthly Bulletin (31 May 1983) as cited in Ta K'ung Páo (Impartial Daily), Hong Kong, 5 June 1983, p.3. The FAO grain statistics differ from the Chinese official figures due to difference in coverage.

2. Kueh, (1980).

3. State Statistical Bureau (SSB), (1982), p.138.

4. This will be discussed in detail later.

5. Chao (1970), p.240.

6. SSB (1982), p.201.

7. Tang, (1982b), p.20.

8. For details of the underlying methodology and assumptions see Kueh (1983b).

9. Tang (1980a) (1982).

10. McQuigg (1977a) (1977b).

11. McQuigg (1977b), p.387.

12. Thompson (1969) (1970).

13. Kueh (1983b).

14. Ibid.

15. Kueh (1982b), p.43.

16. Wiens (1978).

17. SSB (1983).

18. See FAO Monthly Bulletin cited in Footnote 1.

19. Kueh (1983b).

20. Wiens (1982).

21. Walker (1981), p.221.

22. Consult Shanxi College of Agriculture (1975), pp.182-8.

23. Agricultural Yearbook Compilation Commission (1981), pp.375-6. See also Tang (1982a), pp.328-330 for a discussion of the agricultural price reform.

24. Ma (1982), pp. 114-5, Luo, (1983), p.3.

25. Ibid. p.5; and An (1983), p.6.

26. Ma (1982), p.115.

27. SSB (1983).

28. Luo (1983), p.4.

29. Wu (1983), p.2.

30. Agricultural Yearbook (1981), p.58.

31. There are of course other important policy changes concerning the rural area in China. Following the adoption of the new National Constitution in December 1982, for example, there has now come to a nationwide experiment to convert the People's Commune into pure economic entity responsible exclusively for the management of the rural non-farm enterprises. The political and administrative powers of the Commune are being retranferred to the traditional xiang (rural township) government, which will also serve as the vertical agricultural planning link between the xian (county) and the production teams which have in turn been renamed as agricultural cooperatives in scattered localities. This reversion to the pre-1958 (or even pre-1956) status will not, however, seriously affect the policy reforms as elaborated. By April 1983, only about 2% of the total number of xian in China have undergone such changes. For detail of these changes see the forthcoming updated version of Kueh (1982b).

32. Luo (1983), p.3; Zhang (1983), p.49.

33. Estimated with data from various Chinese official sources including the state budgets for 1979-1982.

34. National People's Congress, (1983), p.174.

35. Kueh (1982b), ch.5.

36. Kueh (1982a).

37. Kueh (1982b), ch.4.

38. Luo (1983), p.4; Da (1983), p.47.

39. Da (1983), p.47.

40. SSB (1983).

41. Agricultural Yearbook (1982), p.67.

42. Islam (1974), p.xvii.

43. Derived from figures given in Economic Yearbook Compilation Commission (1982), p.v-12, in consultation with Agricultural Yearbook (1981), p.34-5, and SSB (1982), p.139.

44. Kueh (1983b).

45. SSB (1982), p.138.

46. Kueh (1982b), p.36.

47. Economic Yearbook (1982), p.v-14.

48. Zhang (1983), p.51.

49. Ibid, p.52.

50. State grain procurements fall now in one of three categories. In addition to the familiar obligatory quota delivery (Zhenggou) and "assigned" above-quota sales (Paiguo) comes the new siphoning instrument of "negotiated sales" (Yiguo) which means sales at negotiated (market) prices.

51. Compare SSB (1982), pp.143 and 341.

52. Gullo (1982), p.101.

53. Surls (1982), pp. 131-2.

54. Ibid., p.129. See Barnett (1981), pp.350-9 for a more general discussion on China's grain trade.

55. Donnithorne (1970).

56. Estimated on the basis of the grain output and population statistics given in SSB (1982) and the per capita grain consumption level reconstructed by Walker (1982) which is agreeable with the latest estimate made by Klatt in March 1983 (see also footnote to Table 6).

57. Walker (1981) classified these three provinces as "grain-rich" by the late 1970's within his tripartite division of poor, adequate and rich provinces in terms of per capita grain production.

58. Mah (1971) argued that time that internal transportation bottleneck was not so much a problem causing China to import wheat as the basic subsistence requirement.

59. SSB (1982), p.163, and Kilpatrick (1982).

60. Surls (1982), p.129.

61. Gullo (1982), p.101; and Surls (1982), p.131.

62. Zhang (1983), p.51.

63. Liu and Yeh (1965), p.132. See also footnote to Table 6.

64. Kilpatrick (1982), p.456-7.

65. Ibid, p.457. According to Tang (1980b), p.35 the conversion rate of 6 to 1 is for beef only.

66. Ibid, p.456.

67. Ibid, p.455.

68. Kilpatrick's estimates (1982), p.456 were based on alternative assumptions about annual grain production growth rates (2% and 3%) and population growth rates (1.2% and 2%). The figures cited here are the averages of those based on the higher and lower assumptions.

69. Ibid, p.456.

70. Gullo (1982), p.101.

71. Surls (1982), p.134.

72. Compare General Administration of Customs Statistics of the People's Republic of China (1982), pp.40-41 and 54-55.

73. The average annual growth rates are as follows: Rice 1.7% from 1978-1981 and 4.2% from 1978-1982; wheat 3.5% and 6.2% respectively.

74. There seems to be an enhanced propensity to consume more bread in the urban centres in Hong Kong, Taiwan and Singapore; and not to mention Japan. In China it has been

very much propagated for a while, at least in 1978/79.

75. Surls (1982), p.134.

76. Ibid.

77. Note that the total number of xian in China is around 2,700.

REFERENCES

Agricultural Yearbook Compilation Commission (1981). The Agricultural Yearbook of China 1980, Beijing, Nongye Chubanshe.

Agricultural Yearbook Compilation Commission (1982). The Agricultural Yearbook of China 1981, Beijing, Nonye Chubanshe.

An, Ping-sheng (1983). "On the Development of the Agricultural Responsibility System", Jingji Guanli (Economic Management), No. 3 (March), pp.5-7.

Barnett, A. Doak (1981). China's Economy in Global Perspective, Washington, D.C., The Brookings Institution.

Chao, K. (1970). Agricultural Production in Communist China, Madison, University of Wisconsin Press.

Coppock, Joseph D. (1977). International Trade Instability, Farnborough, English, Saxon House.

Da, Feng-guan (1983). "Probe of the System of Responsibility Contracted in Relation to Agricultural Output," Nongye Jingji Wenti (Problems of Agricultural Economics), No. 1 (January), pp.41-49.

Donnithorne, A. (1970). China's Grain: Output, Procurement, Transfers and Trade, Occasional Paper No. 2, Economic Research Centre, The Chinese University of Hong Kong.

Economic Yearbook Compilation Commission (1982). The Almanac of China's Economy 1982, Beijing.

Food and Agriculture Organization of the United Nations (1981). Trade Yearbook 1980, Rome.

Food and Agriculture Organization of the United Nations (1982). Production Yearbook 1981, Rome.

General Administration of Customs of the People's Republic of China (1982). China's Customs Statistics, No. 3 (December), Beijing.

Gullo, Damian T. (1982). "China's Hard Currency Export Potential and Import Capacity Through 1985," in Joint Economic Committee, U.S. Congress, China under the Four Modernizations Part 2, Washington, D.C., U.S. Government Printing Office, pp.83-108.

Islam, Nurul (1974). Agricultural Policy in Developing Countries, New York, John Wiley and Sons.

Kilpatrick, James A. (1982). "China: The Drive for Dietary Improvement", in Joint Economic Committee, U.S. Congress, China under the Four Modernizations, Part 1, Washington, D.C., U.S. Government Printing Office, pp.449-461.

Klatt, Werner (1983). "The Staff of Live: Living Standards in China, 1977-81," The China Quarterly, No. 93 (March), pp. 17-50.

Kueh, Y.Y. (1980). "Book Review of Charles Greer, Water Management in the Yellow River Basin of China (Austin and London: University of Texas Press, 1979), and E.B. Vermeer, Water Conservancy and Irrigation in China (The Hague: Leiden University Press, 1977)", The China Quarterly, No. 82 (June), pp.358-60.

Kueh, Y.Y. (1982a). "Book Review of Nickum, James E. (eds.), Water Management Organization in the People's Republic of China, (New York, M.E. Sharpe)", The China Quarterly, No. 91, (September), pp.515-517.

Kueh, Y.Y. (1982b). Local Level Planning in China, International Labour Organization, World Employment Programme Research.

Kueh, Y.Y. (1983a). "Economic Reform in China at the Xian Level." The China Quarterly, No. 96 (December), pp. 665-688.

Kueh, Y.Y. (1983b). "Weather Conditions and Grain Yield Instability in China, 1952-1981," mimeo.

Liu, Ta-chung and Kung-chia Yeh (1965). The Economy of the Chinese Mainland: National Income and Economic Development 1933-1959, Princeton, Princeton University Press.

Luo, Shuhua (1983). "The Development of the Agricultural Responsibility System and Questions Raised in the Course of Its Application," Nongye Jingji Wenti (Problems of Agricultural Economics), No. 3 (March), pp.3-9.

Ma, Hong (1982). The Contemporary Chinese Economy: a compendium, Beijing Zhongguo Shehui Kexue Chubanshe.

Mah, Feng-hwa (1971). "Why China Imports Wheat," The China Quarterly, No. 45 (January/March), pp.116-128.

McQuigg, James D. (1977a). "Effective Use of Weather Information in Projections of Global Grain Production," in Douglas Ensminger (ed.), Food Enough or Starvation for Millions (Seminar on Food, Population, and Agricultural Development, Rome, 1975), New Delhi, McGraw Hill, pp.312-323.

McQuigg, James D. (1977b). "Climatic Constraints on Food Grain Production in Frank Schaller (ed.) Proceedings of the World Food Conference of 1976, June 27-July 1, Ames, Iowa, Iowa State University Press, pp.387-394.

National People's Congress (Bureau of the Standing Committee) (1983). Conference Documents of the Fifth Session of the Fifth National People's Congress of the People's Republic of China, Beijing, Renmin Chubanshe.

Shanxi College of Agriculture (1975). Edaphology, Beijing, Renmin Jiaoyu Chubanshe.

State Statistical Bureau (1982). The Statistical Yearbook of China 1981. Hong Kong: Economic Reporter Publishing House.

State Statistical Bureau (1983). "Communique on Fulfillment of China's 1982 National Economic and Social Development Plan," in Ta K'ung Pao (Impartial Daily), 30 April 1983.

Surls, Frederic M. (1983). "China's Grain Imports," in Joint Economic Committee, U.S. Congress, China under the Four Modernizations, Part 2, Washington, D.C., U.S. Government Printing Office, pp.127-136.

Surls, F.M. and Francis C. Tuan (1982). "China's Agriculture in the Eighties," in Joint Economic Committee, U.S. Congress, China under The Four Modernizations, Part 1, Washington, D.C., U.S. Government Printing Office, pp.419-448.

Tang, Anthony M. (1980a). "Trend, Policy Cycle, and Weather Disturbance in Chinese Agriculture, 1952-1978," American Journal of Agricultural Economics, Vol. 62 (May), pp.339-47.

Tang, Anthony M. (1980b). "Food and Agriculture in China: Trends and Projections, 1952-77 and 2000," Tang, A.M., and Stone, B. (eds.) Food Production in the People's Republic of China, Washington, D.C., International Food Policy Research Institute.

Tang, Anthony M. (1982a). "China As a Factor in the World Food Situation," American Journal of Agricultural Economics, Vol. 64 (May), pp.323-31.

Tang, Anthony M. (1982b). Chinese Agriculture: Its Problems and Prospects, Nashville, Vanderbilt University, Working Paper 82-w09.

Thompson, Louis M. (1969). "Weather and Technology in the

Production of Corn in the U.S. Corn Belt", Agronomy Journal, Vol. 61 (May-June), pp.453-56.

Thompson, Louis M. (1970). "Weather and Technology in the Production of Soybeans in the Central United States", Agronomy Journal, Vol. 62 (March-April), pp.232-36.

Walker, Kenneth R. (1981). "China's Grain Production 1975-80 and 1952-57: Some Basic Statistics," The China Quarterly, No. 86 (June), pp.215-247.

Walker, Kenneth R. (1982). "Interpreting Chinese Grain Consumption Statistics," The China Quarterly, No. 92 (December), pp.575-88.

Wiens, Thomas B. (1978). "Chinese Agriculture: Continued Self-reliance," American Journal of Agricultural Economics, Vol. 60 (December), pp.872-77.

Wiens, Thomas B. (1982). "The Limits to Agricultural Intensification: The Suzhou Experience," in Joint Economic Committee, Congress of The United States, China under the Four Modernizations, Part 1, Washington, D.C., U.S. Government Printing Office.

Wu, Xiang (1983). "Combined Contract Responsibility System and Agricultural Planning," Nongye Jingji Wenti (Problems of Agricultural Economics), No. 2 (February), pp.3-10.

Zhang, Wei De (1983). "Baogan Daohu as the Road to a New Rural Economy," Jingji Guanli (Economic Management), No. 1 (January), pp.49-53.

中國的糧食生產與世界性的糧食市場

（中文摘要）

中國人口約佔全世界的四分之一，糧食產量也佔將近20%，因此國內糧食供給之盈虧，都可能導致大宗之糧食出口或進口，從而影響世界糧食市場之波動。

近年來，因爲農村體制的改革發揮了積極的作用，加以氣候條件較佳，使全國糧食產量有顯著之增長。估計八十年代末期或較早，中國將逐步由糧食淨進口國轉化爲淨出口國。

1990年時潛在的淨出口量界乎 400 至1500萬噸之間。本世紀末或可達1900至3400萬噸。當然，實際進出口數量的多寡，視乎國家的糧食消費政策及一般性的消費政策而定。

同時，氣候條件對國內糧食生產與進出口量仍然可能發生顯著之影響。經過三十年來之水利建設，大規模之氣候變異，看來不可能造成像1959－1961年那般嚴重之災害性歉收。但是，根據目前的預測趨勢來判斷，像1980年程度的自然災害，假定在1990年重演的話，還是可能使該年的預測產量減少2800萬噸，預測糧食貿易順差轉化爲逆差。

另外一種可能發揮作用的不穩定性因素，是農村管理體制的逐步自由化與市場化。政府逐漸採用相對價格的操縱辦法（市場調節）來取代傳統的實物控制方法（統購統銷）。這無疑使農民的經濟決策權限擴充；可根據價格與所得之變動，於糧棉之間，或農商（工）之間，進行一定的選擇。同時，家庭式的經營方式，也使農民傾向於短期收益的投資。這在一定程度上可能影響長期的水利建設。