China: the soyabean–pork dilemma

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In 1996 the population of China reached 1·23 billion, 22 % of the world population, and is expected to increase to 1·5 billion by 2020. As China has only 7 % of the world's arable land such population increases are likely to have an important impact on food supply in China and the world. Projections of the potential impact are discussed. The restructuring of Chinese agriculture at the end of the 1970s has led to dramatic increases in agricultural production and food consumption, in particular of animal products, fruit and vegetables. Along with these rapid changes there is evidence of a nutrition transition in which diseases associated with affluence are becoming more prevalent than deficiency diseases. This transition has led to concern about the evolving dietary pattern. The replacement of legumes, including soyabean, by meat and other animal products as rich sources of protein and other nutrients has been controversially argued on grounds of nutritional health, ecological impact, economic effects and world food supply. These arguments are reviewed and the pressures internal and external to China concerning the production and consumption of animal *v*. legume products are presented. It is concluded that nutritional policies to promote the consumption of soyabean are unlikely to be effective in the context of an increasingly free and global market.

China: Food supply: Animal products: Legumes: Soyabean

Population and food supply

In 1996 the population of China reached 1·23 billion and, despite the one-child policy, the population is expected to increase to 1·3 billion by the year 2000 and 1·5 billion by 2020 (Food and Agriculture Organization, 1998). China has 22 % of the world population, but only 7 % of its arable land. Each year 14 million are added to the population, while over the last decade $0{\cdot}5\times10^6$ ha/year have been transferred to non-agricultural use (Jiang & Wang, 1996). Changes in China's population and food production are likely, therefore, to have an important impact on food supply and nutrition in China itself and also on the world. The possibilities for expansion of cultivated land area and water supply are limited, and so the efficient use of that land for food production is critical. Other important determinants of food availability and intake are income levels, income distribution and capacity to import. One issue in food and nutrition policy is the extent to which the production and consumption of animal products should be encouraged or resisted. Soyabean products have traditionally formed important protein-rich foods, while pork has been the main animal-protein source. Current trends show a rapid increase in the consumption of animal products since 1980, and a decrease in the consumption of pulses.

Economic development

China is going through rapid economic development, especially since the 1979 reforms that shifted responsibility for food production from the collective farming system to the household. Development has led to increased urbanization and changing food demands, with particularly rapid increases in the consumption of animal products, fruits and vegetables. A major reason for these demographic changes has been the rapid increase in real incomes, which increased by 100 % in rural and 87 % in urban areas between 1978 and 1988 (Pinstrup-Andersen *et al*. 1991).

Production increases

The dramatic changes in food production in relation to population are shown in Table 1 for cereals, legumes, fruits, vegetables and animal products, as well as the percentage change between the 1978–80 baseline and 1996–8. In 1996–8 cereal production increased by 59 %, the greatest

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Table 1. China food production ($\times 10^3$ t; 3-year averages)

	1961–3	1963–5	1968–70	1973–5	1978–80	1983–5	1988–90	1993–5	1996–8	1996–8 *v.* 1978–80 (% change)
Total cereals	122 464	150 612	184 784	233 632	281 985	350 445	374 599	407 723	448 904	59
Wheat	16 498	21 532	27 985	40 468	57 263	85 005	91 492	102 636	114 620	100
Rice	66 063	84 288	102 904	126 734	143 217	174 773	181 822	181 718	197 582	38
Maize	18 309	22 346	30 225	43 033	59 637	68 719	84 749	105 049	119 322	100
Vegetables	58 673	45 710	46 670	47 481	56 162	86 000	126 018	189 248	233 869	316
Fruit	3252	3718	4998	6598	8254	12 047	20 102	37 772	51 733	527
Treenuts	192	203	221	265	284	270	344	418	465	64
Soybeans	6597	7032	8195	7756	7690	9995	10 969	14 948	13 910	81
Other pulses	9517	9229	6391	6262	6667	5970	5675	4525	4536	–32
Total meat	3310	5684	7506	9610	12 808	18 565	28 078	44 100	53 593	318
Pigmeat	2342	4575	6096	7778	10 414	15 458	22 351	31 784	36 210	248
Beef and veal	64	95	124	174	213	305	931	2626	3882	1726
Other red meat	207	263	376	500	641	920	1436	2345	3023	372
Poultry meat	697	750	910	1158	1541	1883	3361	7345	10 478	580
Eggs	1544	1610	1868	2221	2781	4518	7578	14 744	21 264	665
Milk	1873	1933	1897	2273	2792	4353	6666	8763	10 585	279
Fish and seafood	3864	4034	4564	6059	6561	9384	17 646	34 060		419*
Population ($\times 10^6$)	682·8	712·6	809·6	909·9	985·5	1054·9	1138·8	1208·2		23*

* No data available for 1997, 1998; percentage change shown for 1993–5 *v.* 1978–80.

increase being in wheat (100 %). There was a reduction in the production of pulses (–32 %), except for those included within oil crops, of which more than two-thirds were soya-beans which increased by 81 %. The greatest overall increases were in fruit (527 %), fish and seafood (419 %), vegetables (316 %) and total meat production (318 %). Pork was by far the largest component (68 %) of meat production and had grown by 248 %, followed by poultry which increased by 580 %, and beef which, although relatively small, had dramatically increased by 1726 % (Food and Agriculture Organization, 1998). In contrast the population increased by 23 %.

Agricultural reforms

The People's Republic of China was founded in 1949, after which a series of agricultural reforms have determined rural and urban production and consumption. The first national land reform programme, initiated in the 1940s in areas under the control of the Communist Party, in which land was confiscated from landowners and redistributed to the tenants, was completed by 1952. Collective farms were promoted to support the heavy-industry-oriented first 5-year plan, and these farms were merged into People's Communes in 1958 when private farming was formally abolished (Piazza, 1986). The government established comprehensive agricultural planning, including research and investments. Failure of the Great Leap Forward which attempted to extend heavy industry to rural areas, 2 years of climatic disasters in 1960–1, and the initial lack of personal incentives in the agricultural system, led to the collapse of agricultural production in 1959–62, and a famine in which it has been estimated that thirty million people died of starvation and malnutrition.

After this crisis the government took steps to correct the problems of inefficient management and weak incentives by reducing commune sizes, devolving control to smaller units at the level of production brigades (equivalent to a large village or two to three small villages) and production teams of twenty to thirty households (small village). Modern inputs were emphasized, including powered irrigation, mechanization, chemical fertilizers and pesticides, and high-yielding varieties of grain and other crops, so that after one decade, in 1970, 80 % of traditional rice and wheat was replaced by modern dwarf varieties, and subsequently by higher-yielding hybrid rice (Lin, 1997).

However, cereal production continued to increase at a rate only slightly greater than that of the population, and at the end of the Cultural Revolution in 1976 major reforms were instituted that gave priority to individual incentives and reduced government intervention. By the end of 1983 almost all rural households had adopted the 'household responsibility system'. Agricultural land was contracted to households for a period of 15 years, and farmers became legally entitled to retain or sell any production that exceeded the procurement quota. Other restrictions such as those on agricultural markets were removed. In 1993 a new policy allowed land contracts to be extended for another 30 years after existing contracts expired, land could be leased to other households, and households could then hire temporary labour for farm work. Land and labour markets have therefore re-emerged in rural China. This shift to the household responsibility system has been very successful in terms of agricultural productivity, but has also led to increasing disparities of income and food consumption.

Nutrition transition

Following the recent increase in affluence and urbanization, China has entered the stage of nutrition transition in which increases in overnutrition and chronic diseases appear alongside the decline in undernutrition and infectious

https://doi.org/10.1017/S0029665199000464 Published online by Cambridge University Press

diseases (Popkin, 1998). Overweight and obesity are becoming prevalent in urban areas, and increasing in rural areas along with the decline in undernutrition (Geissler *et al*. 1995, 1998). The third National Nutrition Survey (Ge, 1996), which was conducted in 1992, showed that 14·6 % of adults had a BMI of more than 25 kg/m^2, 23·1 % in urban areas and 10·2 % in rural. In comparison with previous surveys the prevalence of overweight in young adults (20–45 years) had increased markedly in urban areas.

An important question for nutrition and health policy is whether it is possible to eradicate deficiencies and also prevent the detrimental health effects of economic development before they reach the proportions experienced by Western countries. Most of these chronic diseases are multifactorial, so that factors such as the high prevalence of smoking, environmental pollution, and reduced physical activity have to be addressed along with nutritional factors. One of the nutritional issues is the rapid increase in the consumption of meat and other animal products, displacing the alternative protein-rich foods (legumes and in particular soyabeans), and increasing fat consumption.

Can China continue to feed itself?

Several popular authors predict that feeding the expanding numbers of more affluent people in China will bring global environmental and nutritional disaster within a few decades, and other studies have analysed the long-term trends and options for food production and consumption in China. The reviews show that projections of China's balances of grain into the 21st century vary greatly, and the reasons for these differences have been explored (Huang *et al*. 1997; Pinstrup-Andersen *et al*. 1997; Roselle & Rosegrant, 1997). Huang *et al*. (1997) of the International Food Policy Research Institute (IFPRI) note that many projections have failed to take into account the rapid social transformations in an economy that is industrializing at one of the fastest rates in the world, including market development, urbanization, environmental degradation, privatization and budget stress which affects national investment. These factors are included in the IFPRI projection models on growth of future demand and supply. Based on variations of these and other factors the IFPRI provide baseline (the most likely scenario) and high and low growth-rate projections. Pinstrup-Andersen *et al*. (1997) summarize the results of the IFPRI model. In the baseline scenario meat production is projected to increase between 1993 and 2020 by 132 % (almost keeping up with demand), cereal production by 31 % and cereal demand by 42 %. The resulting 41×10^6 t cereal deficit in 2020 would be met by imports which would represent 18 % of projected cereal imports in developing countries. The authors estimate that, although large, this amount would not pose an intolerable burden on the global food situation. Only with very rapid income growth, severe resource degradation, and failure to invest in agriculture would China's net cereal imports be large enough to have a significant effect on world cereal prices (Rozelle & Rosegrant, 1997). Similarly, livestock production above baseline estimates would rely more on grain-based feed and less on backyard foraging, and meat imports would also escalate, raising world meat prices. However, this impact could be offset by technical changes in the Chinese livestock sector to promote efficiencies in animal feed use. The authors conclude that China is already a significant player in world food markets and is likely to become increasingly important, but does not represent a major threat to world food markets.

These projections describe likely and possible future scenarios but do not discuss either the desirability in terms of health, economic and environmental factors, or the policy options other than price to alter the projected trajectory.

Consumption patterns

Data on dietary changes in China are derived from four major survey sources, the National Nutrition Surveys carried out in 1959, 1982, 1992, the China Health and Nutrition Survey from 1989 onwards, and the Diet, Lifestyle and Mortality Studies in 1983 and 1989, and the State Statistical Bureau (annual). Food consumption changes over the post-reform years can be divided into two periods; during the first (1979–1984) the deficit in quantity was made up, and in the second (1985–) the pattern of food consumption altered, with *per capita* consumption of cereals, root crops, legumes and soyabean declining and consumption of animal products increasing, especially in the higher-income groups. Pork has been the main meat, accounting for more than 80 % of the total meat consumption, up to 1990, but has subsequently declined to less than 70 %. Nutrition surveys confirm production statistics, and comparison of the National Nutrition Surveys of 1992 and 1982 (Ge, 1996) indicates that the energy intake per reference man decreased by 459 kJ (110 kcal)/d to 9708 kJ (2328 kcal)/d, 97 % of the Chinese recommended dietary allowance (Ge, 1996). Average fat intake increased by 9 g/d to 58·3 g/d, and protein intake increased by 2 g/d to 68 g/d. In 1992, 66·8 % dietary energy was derived from cereals (urban 57·4 %, rural 71·7 %), animal foods provided 9·3 % dietary energy (urban 15·2 %, rural 6·3 %) and fat 22 % dietary energy (urban 28·4 %, rural 18·6 %). The contribution (% total) of protein from cereals was 50–60, from beans 5–6 and from animals 20–30. The use of animal products as a source of protein was 2·5 times higher in the urban than the rural population. There was no difference between the urban and rural populations in the proportion of protein from beans, and as the quantity was low the survey report specified the need to develop the production and consumption of beans (Ge, 1996).

Should these consumption trends continue?

Views on the beneficial and deleterious effects of these consumption trends, and arguments for and against increased consumption of pulses and animal products, are expressed by commentators both within and outside China.

Soyabeans and health

Current nutrition and agricultural policy in China specifically targets increased soyabean production and consumption. The advantages of the soyabean are its many beneficial attributes in comparison with animal foods, and

https://doi.org/10.1017/S0029665199000464 Published online by Cambridge University Press

these benefits are being increasingly researched. On agricultural grounds it provides a high protein yield per land area, and on nutritional grounds it has been shown to: have a high protein content; contain good-quality protein; be low in fat, in particular saturated fat; reduce plasma cholesterol and inhibit blood-clotting mechanisms (both relevant to reducing IHD); maintain bone Ca with potentially-beneficial effects in the prevention of osteoporosis; prevent menopausal symptoms; reduce the incidence of breast cancer (Young, 1991; Messina, 1995; Setchell, 1995; Cassidy, 1996; Wiseman, 1997; Albertazzi *et al*. 1998; Potter, 1998). These actions are attributable to the nutrient and phyto-oestrogen contents of soyabean. Soyabean is used in the Chinese diet in a great variety of products, as unfermented soya milk, and curd and fermented products, including soya sauce. Fermented products provide vitamin B_{12} which can be deficient in meat-free diets in other societies. The nutrient content of soya milk compares favourably with that of cow's milk except in riboflavin and Ca, although the taste differs. Of nutritional concern is the fact that mineral absorption is inhibited by the high phytate content of non-fermented products (Hurrell *et al*. 1992); however, this may be a short-term effect to which there is adaptation.

Nutritional need for animal products?

Meat and milk are important sources of nutrients such as readily-absorbable Fe, Zn, Ca and other minerals, as well as vitamins such as riboflavin and vitamin B_{12}, that are protective against common nutritional problems such as anaemia and restricted growth. Although it is easier to provide adequate quantities of nutrients from diets that contain some animal products, these are not essential if diets include a varied mixture of plant foods, including different cereals, legumes, fruits and vegetables. The malnutrition associated with poverty and poor diets is not necessarily due to the lack of animal products, as is commonly assumed, but due to the lack of variety in general and the monotonous reliance on a small number of foods. Animal products in relatively small quantities can be a useful part of a varied diet, but are not essential and in larger quantities can be detrimental to health.

Meat is held in high esteem by most societies as a food with ‘magical’ and nutritional qualities that is expensive and prestigious (Fiddes, 1994). Consumption increases with affluence internationally, and the rising demand, whether it is based on taste, nutrition, or prestige, is almost universal. Nutritionists also have long extolled the importance of meat in the diet, previously as a good protein source, until 25 years ago when the emphasis on protein was shown to be exaggerated (McLaren, 1974; Carpenter, 1994). However, the legacy of this emphasis still remains in the wider public. Meat is still generally regarded in the scientific nutrition and medical professions as a good and virtually-essential source of vitamins and minerals, in particular Fe, Zn, retinol and vitamin B_{12}, and for adequate child growth. The nutritional desirability of milk products remains a tenet of most nutritional practitioners as a virtually-essential source of riboflavin and of Ca to provide for optimal growth, as well as for high bone density to diminish the risk of osteoporosis and bone fractures in later life. However, the high levels of recommended intakes of Ca (and riboflavin) in developed countries are open to question as to their universality because of adaptation to long-term low intakes (Campbell *et al*. 1990; Prentice, 1997). Contrary to expectations, it is in populations with high Ca intakes that the incidence of osteoporotic fractures is the highest. Studies in China do show that bone mineral content and density are significantly correlated with dietary Ca, especially dairy Ca (Zhao & Chen, 1992; Hu *et al*. 1993*b*). However, despite low intakes of dairy products and Ca in China, fracture rates are amongst the lowest in the world (Hu *et al*. 1993*a*,*b*; Ling *et al*. 1996). Increased urinary losses of Ca are positively correlated in several studies with the consumption of animal protein, whereas plant protein is negatively correlated with urinary Ca losses (Kerstetter & Allen, 1990; Hu *et al*. 1993*a*), because of the high acid load from the catabolism of S-containing amino acids in animal proteins.

The vegetarian movement and many studies of child growth and adult nutritional status have undermined to some extent the firm belief in the nutritional essentiality of animal products. In developed countries there is an increasing acceptance of the evidence that vegetarian diets can be compatible with and even advantageous to health. Even in children several studies show that catch-up growth can occur with diets low in or devoid of animal products. The classical study was that of Widdowson & McCance (1954), carried out in two post-Second World War German orphanages, and several other studies show that child growth can be adequate on vegetarian diets unless they are very restricted (Dagnelie *et al*. 1988; Sabate *et al*. 1991; Sanders & Reddy, 1994). Rates of early child growth lower than current reference standards, which are derived from mainly milk-formula-fed children, may be even beneficial in the long term in relation to subsequent diseases of affluence. Childhood obesity, which may track to adult obesity, is associated with early appearance of the adiposity rebound which occurs on average at approximately the age of 6 years (Rolland-Cachera *et al*. 1984). Associations between protein intake and fatness have been reported in children (Rolland-Cachera & Bellisle, 1986; Rolland-Cachera *et al*. 1995) and adults (Buemann *et al*. 1995).

Animal products and diseases of affluence

The relationship between the consumption of animal products and diseases of affluence has been set out in several recent reviews (Chen *et al*. 1990; World Cancer Research Fund, 1997; Department of Health, 1998; Hu & Willett, 1998).

Hu & Willett (1998) conclude that the health effects of livestock products differ by animal product and by disease, but the epidemiological evidence indicates that diets containing substantial amounts of red meat and its products probably increase risk of coronary disease and some forms of cancer, while replacement of red meat with white can have clear health benefits. However, where haemorrhagic stroke rates are high, very low consumption of animal products may not be optimal. They note that the use of plant sources of protein and fat such as soyabean products, nuts, and vegetable oils may provide greater health benefits than

https://doi.org/10.1017/S0029665199000464 Published online by Cambridge University Press

animal sources and should be considered therefore with other investments in economic development.

The World Cancer Research Fund (1997) review panel concluded in graded judgements based on the strength of the evidence (as convincing, probable, possible, or insufficient evidence) that red meat probably increases the risk of cancer of the colon and rectum, and possibly of the pancreas, breast, prostate, and kidney, while eggs possibly increase the risk of colon and rectum cancer. Saturated animal fats possibly increase the risk of lung, colon, rectum, breast, endometrium and prostate cancer. They also judged that varied vegetarian diets may decrease the risk of oral, pharyngeal, stomach, pancreatic, colo-rectal, breast, ovarian and bladder cancers. The World Cancer Research Fund (1997) recommend that red meat should provide less than 10 % total dietary energy, and intake should be limited to less than 80 g/d. It is preferable to choose fish, poultry or meat from non-domesticated animals in its place.

The report of the UK Committee on the Medical Aspects of Food Policy (Department of Health, 1998) agrees that moderate evidence exists of a relationship between red and processed meat consumption and colo-rectal cancer, which represents 12 % of all cancers in the UK. The report concluded that lower consumption of red and processed meat would probably reduce the risk, but was aware of the possible associated adverse implications on other aspects of health, in particular Fe status. The report recommends for adults that consumption should not rise, and that those with intakes much above the current average of 90 g cooked weight/d (eight to ten portions per week) should reduce their intakes. The recommendations proved highly contentious and delayed publication of the document for several months.

A relationship between the consumption of animal products and diseases of affluence was also found in the Diet, Lifestyle and Mortality Study in China (Chen *et al*. 1990). The study was conducted soon after market reform was being established in rural China, and provided the opportunity to investigate relationships between disease and diet in a country with the unique situation of having a wide range of plant and animal foods and a wide range of mortality rates of different cancers. An extended follow-up survey was carried out in 1989–90 and provides comparative data to document changes that occurred in the 1980s (J Chen, personal communication).

In 1983 the average intakes of dietary fat and fibre in rural China were markedly lower than those in the USA (fat 14 % energy *v*. 36 % energy; fibre 11 g/d *v.* 33 g/d), as were indicators of fat metabolism, with much lower values for blood cholesterol (0·90–1·70 g/l *v.* 1·70–2·90 g/l) and BMI (20·5 kg/m^2 *v*. 25·8 kg/m^2). Groups of diseases characteristic of developing and developed countries were identified (Campbell *et al*. 1992). Closely associated with diseases of developed countries were total blood cholesterol and urea-N. Blood urea-N was mainly associated with intakes of meat, milk and eggs, while blood total and LDL-cholesterol were closely associated positively with consumption of dietary fat, meat and animal protein, and associated negatively with intakes of dietary fibre, legumes and other indicators of plant-food intake, including plant protein. Only small increases in intakes of animal foods were associated with significant increases in blood cholesterol and other chronic degenerative diseases (TC Campbell, personal communication). The lower rates of breast cancer in China were associated with lower concentrations of oestradiol and testosterone, related largely to lower average body weights, but also to other factors including the low-fat diet (Key *et al*. 1990). Plasma levels of dietary antioxidants were consistently negatively correlated with cancer mortality rates. Ascorbic acid was the antioxidant most strongly negatively associated with most cancers and β-carotene was found to have a protective effect independent of retinol, particularly for stomach cancer. These nutrients are provided almost entirely by plant foods (Guo *et al*. 1990; Chen *et al*. 1992).

The average Chinese diet in 1983 was in many respects healthier than that of industrialized nations in relation to degenerative diseases, as it was closer to dietary guidelines in being substantially lower in total fats, saturated fats and sugar, and higher in dietary fibre, β-carotene and vitamin C (Chen *et al*. 1992). However, the situation is rapidly changing, and effective food and nutrition policies are required to pre-empt deleterious changes. These policies include the promotion of appropriate food production as well as consumption.

Development agency policies in China

Agricultural development in China is financed by government and private investment, assisted by loans from agencies such as the World Bank. Several large World Bank projects in China, which include livestock development, have been prepared in recent years. However, there has been some opposition from internal and external pressure groups to support by the World Bank of livestock projects. Arguments against such support are outlined in an internal document of the World Bank Group, entitled *Livestock Sector Environmental Assessment,* and elsewhere (Goodland, 1997, 1998).

Three main arguments are presented for the World Bank to consider concerning the impact of its involvement in the livestock sector in relation to its aims: poverty alleviation; environmental sustainability; nutrition and public health. In relation to poverty alleviation, it is argued that investment in livestock production runs counter to this aim on several grounds: the cost of food is critical to the poor, and periodic rises in grain prices are caused by shortages partly attributed to feeding grain to livestock; investments in livestock reduce the availability of scarce development finance for direct poverty alleviation; livestock products are too expensive for the poor, except when produced in a pastoral setting; large-scale production with feed grain is less efficient than the production of most alternative foods, and decreases employment and hence incomes; the risk of investments in livestock is great if outbreaks of disease force large-scale destruction; as private capital is available for the demand created by the more affluent, it is unnecessary for the World Bank to promote livestock production. In relation to environmental sustainability, it is argued that the main categories of environmental damage reputedly caused by livestock include: deforestation; overgrazing, soil erosion, and desertification; pollution; the inefficient use of scarce water and land resources (of particular relevance to China). In relation to nutrition and public health, comparison is

https://doi.org/10.1017/S0029665199000464 Published online by Cambridge University Press

made with the change in the World Bank's tobacco policy, in which investments in tobacco production were prohibited in 1991, as the adverse health impacts, including a large proportion of deaths from cancer, heart disease, and chronic bronchitis and emphysema, were considered prohibitively large. It is argued that similar statistics from developed countries indicate that livestock products cause 40 % of all cancer deaths, 19–29 % of death from CHD, 36–44 % of all cases of diabetes, 22–68 % of cases of hypertension and 60–70 % of all cases of food poisoning (Barnard *et al*. 1995). The related annual direct costs can be extrapolated to China, on the assumption that they adopt the Western medical model, to estimate the high economic costs of increased meat consumption.

However, the Vice President and livestock specialists of the World Bank have countered these arguments and similar ones presented by the environmental non-governmental organization, the Sierra Club (personal communication). The counter-arguments stated that the projects in question addressed smallholders and not intensive livestock production, with the following objectives: to convert low-value crop residues of rural households in low-income provinces (that would otherwise be burned or wasted) into value-added beef with no cereal feeding; to increase the domestic production of speciality feeds through nucleus agro-enterprises and their satellite low-income household producers; to improve feed efficiency for pigs and poultry and hence save grain for other uses. Furthermore, it was pointed out that livestock (1) provide smallholders with multiple benefits (traction, organic fertilizer and cash income) and improve the sustainability of mixed farming systems, (2) provide a large percentage of household incomes of the rural poor, (3) are an important source of nutrition for the smallholders and urban dwellers, and (4) transfer resources from the urban rich to the rural poor. The World Bank specialists provided evidence that feed conversion factors and water use of livestock are lower than those cited in the critiques, and that many of the environmental impacts cited, such as deforestation and erosion, are not due to livestock *per se* but to the policy framework concerning aspects such as land rights.

The World Bank livestock division commissioned the review summarized previously (Hu & Willett, 1998) on the relationship between the consumption of animal products and nutrition-related disease. Subsequently one of the projects that had reached a late stage in its preparation has been cancelled. There is no clear evidence that cancellation was due to these considerations; however, policy has been swayed in recent years by internal and external pressure groups, as in the case cited previously of tobacco production for which the World Bank no longer provides loans.

Recent Chinese nutrition policy

The consensus in China as in most developing countries is that more protein in general is needed in the national diet, although this is certainly arguable on the grounds of nutrition as opposed to consumer demand. In 1990 an International Symposium on Food, Nutrition and Socio-economic Development was held in Beijing, in which debate was intense between those who sought to promote livestock and those who would promote the soyabean alternative, for agricultural, ecological and nutritional reasons. The recommendations for nutritional policy from a National Workshop in 1989 supported by the Food and Agriculture Organization were reported by Chen (1990). These recommendations included the need to: increase land for soyabean and increase its output; enlarge the share of poultry in total meat to reduce the dominance of pork; strengthen development of fish breeding; set policies on land, price and subsidies favourable to the development of poultry and soyabean production. The consensus of the workshop on the principles of the guidelines for China, based on the Food and Agriculture Organization desirable dietary pattern (Qureshi, 1988), were national average daily intakes of energy 10·0 MJ (2400 kcal), and protein 70 g, with energy contribution of cereals 60 % total energy intake and animal foods 14 % total energy intake, protein intake from animal food and legumes 30–40 % total protein intake, energy intake from fat 25–30 % total energy intake, and salt intake less than 10 g.

Subsequent developments have continued to support this policy of promoting the consumption of both animal foods and legumes (Jiang & Wang, 1996). The National Natural Science Foundation of China published the *Strategy on Food Development for Long- and Medium-Term in China* (Lu & Liu, 1991; see Jiang & Wang, 1996) in which the main resolutions are to continue to concentrate first on plant-food consumption, to increase animal foods 'appropriately', and to encourage the consumption of beans, in order to diversify the diet. Feed production was planned to support animal husbandry so that the production of livestock and poultry with higher feed conversion would be enlarged in order to increase the output of poultry, eggs and milk while maintaining pork production, with the aim that pork as a percentage of total meat would be 65 in 2000 and 62 in 2020 and that for poultry 25 and 28 respectively. For aquatic products cultivation was to be the first priority, both to increase the output and to reduce losses in catches. With these adjustments to food production a shortfall (mainly of feed grain) of $20–25 \times 10^6$ t was predicted by the year 2000.

In June 1993 the State Council approved the document of the programme for Food Structure Reform and Food Development in China in the 1990s. This programme is the first in which the Chinese Government policy co-ordinates food production, consumption and nutrition. The State Food and Nutrition Consultation Committee of China, also founded in June 1993 to provide advice to the State Council, has promoted food development plans at provincial level and proposed a Soy Bean Action Plan to the State Council. This plan is being put into practice by the Ministries of Agriculture, Public Health, the State Education Commission, and the general Association of Food Industry. In ten selected counties and cities one or two primary and elementary schools were selected on an experimental basis. Pupils were provided with soyabean products made from local resources, and nutrition education was given to teachers and pupils. At the end of a 2-year experimental period the programme was to be more widely disseminated. From 1997–2000 the second phase is to select 100 counties and cities, develop a complete set of production, marketing and modern processing techniques for soyabean, and

https://doi.org/10.1017/S0029665199000464 Published online by Cambridge University Press

promote the Chinese soyabean industry. No comparable action plans have been made for the promotion of livestock.

In December 1997 the State Council approved a China Nutrition Improvement Plan which was jointly formulated by various Ministries and associations, and which was based on the World Nutrition Declaration and the World Nutrition Action Plan that were the outcomes of the International Conference on Nutrition in 1992 (Food and Agriculture Organization/World Health Organization, 1992). The proposals and strategies are similar to those approved by the State Council in their 1993 Food Development Programme.

Conclusions

Chinese nutrition and agricultural policy is set with the goal of maintaining certain advantageous aspects of its past food supply by promoting consumption of soyabean as well as meat and other animal products, in particular poultry and fish. An aim is to increase the protein supply but reduce the relative importance of pork. Nutritional arguments for this policy are low intakes of protein (90 % recommended dietary allowance in 1992; Ge, 1996), Ca (50 % recommended dietary allowance), retinol and riboflavin, and the prevalence in children and women of rickets and osteoporosis as well as Fe-deficiency anaemia, despite the apparent adequacy of Fe intake. However, some questions exist about the universal validity of some recommended dietary allowances (e.g. Ca and riboflavin), and other factors (e.g. pollution and parasites) can play a role in these nutrition-related diseases. Protein does provide 12 % of the dietary energy intake, which well covers the recommended dietary intakes for protein energy in relation to total energy, which is 7 % for adults and 4 % for toddlers (Vaughan & Geissler, 1997). Diets free of animal products can be nutritionally adequate, and so the policy of increasing the consumption of animal products may be more attributable to consumer demand, although nutritional adequacy is more easily and reliably achieved by a wide variety of foods, including some animal products. However, many nutritionists would dispute this statement on ethical and environmental grounds.

The National Food Survey in 1992 (Ge, 1996) estimated average total meat consumption per reference man in China to be 60 g/d, which comprised 37 g pork, 9 g other meats, 9 g poultry and 4 g organ meat. Total red meat consumption was therefore 46 g, still well below the 80–90 g limit highlighted by World Cancer Research Fund (1997) and Department of Health (1998), but production and therefore consumption has increased 44 % between 1992 and 1997, and so is rapidly catching up with the quantities consumed in developed countries. The dietary goals set for the year 2000 were close to being met in relation to total energy intakes (energy from cereals, protein and fat as % total energy; Table 2). However, the distribution of protein was not close to reaching the planned pattern apart from the percentage of animal protein which had risen from 11·4 in 1982 to 18·9 in 1992 (goal 20·1). Cereals, previously 66·6 % protein intake, still provided 61·6 % protein intake (goal 54·0 % protein intake) and beans which had provided 10·6 % protein intake in 1982 now provided only 5·1 % protein intake (goal 20·1 % protein intake). It is clear, therefore, that the meat policy is proceeding with success, but the policy for beans is failing, despite the nutritional arguments to support this policy. Consumer demand would appear to strongly favour meat but not beans. It is unlikely in the current economic climate that government policy can effectively counter popular demand. Information has been made available from the State Food and Nutrition Consultation Committee about the means of implementing the soyabean policy by promoting consumption. However, no information is available about the mechanisms in place or planned to increase soyabean production, to indicate whether the written policy is being implemented in practice. The difference in the success of these two aspects of the nutrition policy is likely to be due to the relative demand for, and profitability of production of, animal products compared with soyabeans. Now that China has become a market economy and government control has been reduced, the soyabean–pork dilemma appears to be disappearing, with the population opting for pork and other animal products and abandoning soyabeans. The opportunity to pre-empt the evolution of the negative effects of the nutrition transition appears to have already been lost.

Table 2. Patterns of food consumption and goals in China

	NNS 1982*	NNS 1992*	Goal 2000†
Energy			
Total : MJ	10·4	9·7	10·0
kcal	2485	2328	2391
Cereal (% total energy)	77·5	66·8	65·7
Animal (% total energy)	7·9	9·3	15·4
Protein			
Total (g)	67·0	68·0	76·6
Energy (% total energy)	10·8	11·7	11·8
Animal (% total protein)	11·4	18·9	20·1
Beans (% total protein)	10·6	5·1	20·1
Cereals (% total protein)	66·6	61·6	54·0
Fat			
Total (g)	49·0	58·3	65·9
Energy (% total energy)	18·4	22·0	24·8
Animal (% total fat)	40·3	37·2	50·6
Vegetable (% total fat)	59·6	62·8	49·3

NNS, National Nutrition Survey.
* Ge (1996).
† Chen (1991).

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https://doi.org/10.1017/S0029665199000464 Published online by Cambridge University Press