SCHRIFTEN DER GESELLSCHAFT FÜR WIRTSCHAFTS- UND SOZIALWISSENSCHAFTEN DES LANDBAUES E.V.

Grigg, D.: The Agricultural Response to Population Growth in Pre-Industial and early Industiral Euope and in the Developing Countries since 1950: A Comparison. In: von Blanckenburg, P., de Haen, H.: Bevölkerungsentwicklung, Agrarstruktur und Ländlicher Raum. Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Band 22, Münster-Hiltrup: Landwirtschaftsverlag (1986), S. 61-72.

THE AGRICULTURAL RESPONSE TO POPULATION GROWTH IN PRE-INDUSTRIAL AND EARLY INDUSTRIAL EUROPE AND IN THE DEVELOPING COUNTRIES SINCE 1950: A COMPARISON

von

David G R I G G, Sheffield

---

1. The agricultural response to population growth

Over the last forty years there has been very rapid growth in the population of the developing countries, and this has given rise to fears that it will outrun the rate of increase of food. This is not of course the first time that such fears have been expressed. In the nineteenth century many writers echoed MALTHUS' fears, and in the sixteenth century many Europeans were alarmed at the increase in their numbers, coming as it did after a century or more of stagnant or declining populations. The aim of this article is to compare the ways in which gross food output increases were achieved in nineteenth century Europe with the developing countries 1950-1980.

In the early nineteenth century western Europe had many similarities with the developing countries in 1950. Except in Britain and the Low Countries the majority of the working population were employed in agriculture, urban populations were a small proportion of the total, mortality and fertility were high, and food supplies per capita low, estimates of the national food supply per capita in France suggest food availability no different from South Asia today (TOUTAIN, 1971). After 1800 and 1950 both regions were subject to very rapid population growth, which combined with rising incomes led to a rapid growth in the demand for food.

There is of course a great difference in the rate of change of all the indices noted. Nowhere in nineteenth century did decadal population increase exceed 2 % p.a., yet in few parts of the developing world has population increase been less than 2 % p.a. over the last thirty or forty years, reflecting the far more dramatic decline in mortality in

Afro Asia and Latin America since 1950 than in nineteenth century Europe. But to compensate for this rates of increase in agricultural output have been much higher in the post 1950 Third World than in nineteenth century Europe, although it should be noted that the United States, and probably the land-abundant countries of North America, Australia, Southern Russia (Tables 1 and 2) and parts of Latin America had comparable rates.

There are a limited number of ways in which food production can be increased. If only crop production is considered, then either a greater area can be cropped or yields can be increased, these two methods are not, of course, mutually exclusive. First the area under crops can be increased by cultivating land not previously used. But there are other means. In nineteenth century Europe much of the arable land was not sown to crops every year, and the cropland could be increased by sowing the fallow. Such a possibility is found widely in Africa and in much of Latin America today. A third way of increasing the area under crops is sowing more than once in a year, multiple cropping. In Western Europe the growing season is too short for more than one staple food crop, and this has not been and is not a way of increasing food output, in contrast in the tropics water is the limiting factor, not temperature, and multiple cropping has long been practised in Asia.

Output per hectare can be increased in two distinct ways,by increasing the yields of a crop, or by replacing it by a different crop of higher caloric value. In nineteenth century Europe the adoption of the potato was the classic example of this; there are fewer instances of this in the modern developing countries, where root crops are the major source of calories only in some Andean republics and in West Africa.

There are of course numerous ways in which crop yields can be increased, but for the most part they can be reduced to a few essentials. First by optimising the soil moisture content by underdrainage or irrigation; second by optimising temperature conditions, the possibilities of which are limited to breeding rapid maturing crops or using heated glasshouses. third and most important is to increase the supply of plant nutrients to the growing crop. Such practices embraced a wide range of traditional and modern husbandry practices including the use of farmyard manure, chemical fertilisers, breeding varieties that respond to fertilisers, underdrainage and the use of lime to reduce soil acidity, the elimina-

Table 1: Growth of agricultural output in the nineteenth century: Selected countries

1. France	Percentage per annum	2. United States	Percentage per annum	3. Great Britain	Percentage per annum
1803-12 to 1813-24	0.2	1800-1900	3.0	1801-11 to 1831-41	1.2
1815-24 to 1825-34	1.2	1810-1820	2.9	1811-21 to 1841-51	1.5
1825-34 to 1835-44	1.5	1820-1830	3.2	1821-31 to 1851-61	1.8
1835-44 to 1845-54	1.1	1830-1840	3.5	1831-41 to 1861-71	1.3
1845-54 to 1855-64	1.4	1840-1850	2.3	1841-51 to 1871-81	0.7
1855-64 to 1865-74	0.8	1850-1860	3.6	1851-61 to 1881-91	0.5
1865-74 to 1875-84	-0.05	1860-1870	1.9	1861-71 to 1891-1901	0.7
1875-84 to 1885-94	0.35	1870-1880	4.3		
1885-94 to 1895-1904	0.9	1880-1890	1.8		
		1890-1900	2.4		

Table 2: Rate of increase in food output 1952-4 to 1980 (% per annum)

	1952-4 to 1959-61	1961-70	1971-80
Africa	2.1	2.7	1.8
Far East	3.4	3.5	3.6
Latin America	3.1	3.5	3.8
Near East	3.3	3.0	3.2
Asian C P E	No data	2.7	3.2
All developing	3.1	3.1	3.3
All developed	3.0	2.4	1.9
World	3.1	2.7	2.5

Source: Food and Agriculture Organisation, World Agriculture the last quarter century, Rome, 1970; The State of Food and Agriculture 1981, Rome 1982; The Fourth World Food Survey, Rome 1977.

tion of weeds. Fourth is the elimination of crop disease which can be achieved by breeding crops immune to specific diseases, mixed cropping, fallowing and the use of pesticides.

2. The increase of food production in nineteenth century Europe

Food production increased rapidly in nineteenth century Europe, whereas at the beginning of the century national food supplies were little more than 2000 calories per capita per day, by the end of the century they had reached 3000 calories (WEBER and WEBER, 1974/75), this of course was not entirely due to increases in home production, for food was imported as were feedstuffs. Most historians who have described the changes in food production in nineteenth century Europe have emphasised the increases in crop yields, but other means were important. Of most importance was the increase in the area in crops. In nearly all West European countries the area in arable land increased from the end of the eighteenth century to the end of the nineteenth century (Table 3), after which it stabilised, and since 1945 has declined. An important source of new land

was the draining of lowland areas, made more efficient by the use of the steam pump, whilst cultivation advanced upwards in mountainous areas. But perhaps more fundamental was the reduction of the area in fallow. In 1800 fallow was still a substantial part of the arable area in all of Western Europe except the Low Countries, by 1900 it had been greatly reduced, planted with fodder roots, sugar-beet, potatoes and clover, adding considerably to the output of food (Table 4).

Table 3: Arable land in selected countries in Western Europe, 1800-1900

	Million hectares			
	c 1800	c 1850	1860	c 1900
France	23.7	26.1	26.6	25.2
Sweden	1.5	-	3.2	3.6
England and Wales	4.5	5.4	5.7	4.9

Table 4: Percentage of arable land in fallow

	c 1800	1850	1890	1900
France	34	20	13	-
Sweden	c 30	19	-	7
England and Wales	c 17	6	-	-

The introduction of new higher yielding crops was of major importance in increasing the food supply in nineteenth century. The potato had a lower caloric value than most of the cereal crops grown in Western Europe, but its far higher output per hectare meant that food output per hectare was far greater. Little grown in the early eighteenth century, it had increased substantially by 1800, particularly in the more densely populated areas such as the Low countries and Ireland, although

some have suggested that it replaced cereals rather than being a net addition to food output. In the nineteenth century potato output continued to increase throughout Western Europe. By the mid nineteenth century it occupied 5 % of Swedisch arable land, 12 % of Norwegian, and one third of Irish cropland, in the latter country it was the major food of 40 % of the population, in Norway of one-fifth. Indeed some authorities believe that the adoption of the potato was a primary cause of the rapid population growth of the nineteenth century rather than merely a response to the growing demand for cheap food (DRAKE, 1969; VANDENBROEKE, 1971; BOURKE, 1967/68).

Most historians have argued that the prime cause of the increased food output in the eighteenth and nineteenth centuries was the increase in cereal yields, for these crops remained the major source of food intake until the late nineteenth century. Data on yields is unreliable, for accurate figures were not collected in most countries until the later part of the century. Such evidence that there is suggests that overall output per hectare did not increase by more than 50 %, although locally increases may have been more dramatic (Table 5). Increased yields were obtained by increases in the area of leguminous crops, and hence the nitrogen supply, the increase in the application of farmyard manure, and more use of labour in weeding and seed-bed preparation. The agricultural labour supply increased everywhere except England and Ireland until the later nineteenth century. Chemical fertilisers were of minor importance, and there were few means of controlling crop diseases, which had in the cases of the potato, disasterous consequences, notably in 1848-50.

Table 5: Wheat yields in the nineteenth century

	kg/hectares				
	c 1820	1840	1850	1870	1900
England and Wales	1430	--	1885	--	2110
Sweden	1180	--	--	1390	1560
France	780	940	--	1125	

That there was a substantial increase in food output in nineteenth century Europe is undeniable; furthermore food consumption per capita increased dramatically, so that by the late nineteenth century calories per capita per day were 50 % or more above the beginning of the century. As late as the 1900s however, the bulk of the European diet was still derived from cereals and potatoes. In France 80 % of all calories were still derived from vegetable foods as was 68 % of all protein, the comparable figures for 1965-6 were 55 % and 45 % (TOUTAIN, 1971). Three points are of importance. First, crop yield increases were not responsible for the majority of the increased crop output. The colonization of new land together with the reduction of fallow increased the sown area, whilst the widespread adoption of the potato increased the calorific output per hectare. Thus it has been estimated that during the classic period of the agricultural revolution in England, between 1750 and 1850, two thirds of the increase in output came from expansion of the area in crops, only one third from higher yields (MINGAY and CHAMBERS). Second, most of the increased output was obtained by traditional means. Even late in the nineteenth century few inputs from industry were used in West European agriculture, the selective breeding of new varieties, the use of chemical fertilisers, pesticides and herbicides awaited the twentieth century, tractors were unknown, oxen, horses and human labour still the prime power input. Third, the late nineteenth century saw the increasing importance of food imports. The significance of this varied greatly from country to country, being greatest in the United Kingdom. Not only were tropical foodstuffs imported in increasing bulk as European incomes increased, but also more staple foods such as bread grains and meat. In addition animal feedstuffs became a significant part of Europe's agricultural imports; thus the food products of Europeans overseas became an important contribution to Europe's food supplies in the nineteenth century (STERN, 1960).

3. Western Europe 1950-1980

The population of Western Europe has increased comparatively slowly since 1950; although income increases have led to increases in demand for livestock products, the post-war period with protection for farmers at high prices and the availability of the technical means to increase productivity has led to the food surpluses of the last ten to fifteen years. However, the major point here is that increases in crop output

have come almost entirely from higher yields. By 1950 fallow had disappeared, except where still used for agronomic reasons, and there has been little colonization of new land. In many parts of Europe urban expansion has reduced the agricultural area. In all the countries of Europe the arable area is now lower than it was in 1950. In contrast, increases in area expansion have been important in other developed countries. Substantial increases in output came from the colonization of new land in the Soviet Union in the late 1950s, in Australia, and in the cropping of idle land in the United States in the 1970s. It seems likely that any future increases in output in Western Europe will come from higher yields, and marginal land may go out of cultivation.

4. The developing countries since 1950

The abrupt decline of mortality after 1945 in Afro-Asia and Latin America, without, until the late 1960s, any fall in fertility, led to very rapid population growth, the population of the three developing continents doubling between 1950 and 1980. This led to many gloomy predictions about food supplies per capita, which in the event have not been fulfilled. By 1976, global output per capita was 28 % above 1950 (SIMON, 1980). Nor was this increase confined to the developed countries; food output per capita was 10-15 % above 1950 in Latin America, the Near East and Far East, and possibly in China. The only exception is tropical Africa where food output per capita has been falling since the mid 1960s, and a few parts of Latin America (GRIGG, 1985).

The means by which food output has been increased since 1950 has varied greatly from country to country. However, most attention has been paid to increasing crop yields. It is this that has preoccupied most agronomists who advise developing nations, whilst the adoption of new high yielding varieties of wheat and rice since 1965 has attracted much attention. However, other means of increasing food output have been of major significance.

The area sown to food crops in the developing world has increased by nearly one third 1950-1980, but the additions were small in Asia, and very substantial in Latin America and Africa (Table 6). Indeed, in Latin America two thirds of the increased agricultural output has come

from increasing the area in crops. Multiple cropping is rare in Latin America. Even on Mexico's irrigated lands only 15 % is douple-cropped. Nor has the reduction of fallow been of much importance except in the densely populated areas of southern Mexico and the Andean altiplano; and the consequences of this have been largely adverse. Hence the colonization of new land has been of the greatest importance, particularly in southern Brazil and on the Pacific coastlands of Central and Southern America.

Table 6: Changes in the area in major food crops, 1950-1980

	(Million hectares)		Change 1950-80	
	1948-52	1979-80	Million ha	%
Latin America	43.5	86.7	43.2	99.3
Asia	337.7	393.0	56.6	16.4
Africa	57.8	98.9	41.1	71.1
Total	439.0	578.6	139.9	31.9

Source: FAO Production Yearbook 1981, Vol. 35, 1982, pp 93-137;
Production Yearbook, 1976, Vol. 30, 1977, pp. 89-134;
Production Yearbook, 1957, Vol. 11, 1958, pp 31-2.

This is not to suggest that increases in crop yields have not been of significance in Latin America. Mexico, after all, is the home of the hybrid wheats that have transformed many parts of Asia. Their importance has increased over time (Table 7).

There are few reliable estimates of the growth of area or yield or food output in tropical Africa over the last forty years. However, most authorities believe that there has been little increase in the yields of the staple food crops except in limited areas. This is partly due to the very limited use of new inputs such as fertilisers or new crop varieties, but also due to the reduction of fallow which remains the main means of maintaining soil fertility. Nor have there been any substantial gains in the colonization of entirely new land. Most of the numerous settlement projects in Africa have been resettlement schemes

Table 7: The contribution of area expansion and yield increase to extra food output in Latin America, 1935-1980

% of increased output							
c 1935-1955		1960-1970		1970-1980		1950-1980	
Area	Yield	Area	Yield	Area	Yield	Area	Yield
80	20	70	30	60	40	66	34

Source: G. GOMEZ and A. PEREZ, The process of modernization in Latin American Agriculture. Cepal Review, Vol. 8, 1979, pp 55-74.

or the allocation of European land to Africans, and hence not a net gain in cropland. Yet, although food output per capita has been falling in tropical Africa, food output has been increasing, although more slowly than in Latin America or Asia (Table 2). How has this been achieved? Largely by area expansion, and of prime importance in Africa farming systems, but the increase in population and the spread of commercial crops has prompted the increase in the period in crops at the expense of the natural fallow.

Not unnaturally there have been great variations in the way in which food output has been increased in the great continent of Asia. Thus in China, 90 % of the increased food output since 1950 has been attributed to higher crop yields (WALKER, 1981); in contrast, in Thailand there has been little increase in yield, but a substantial increase in the area in crops. But, in the continent as a whole the colonization of new land has been relatively unimportant over the last fifty years, although contributing a significant proportion of extra output in the 1950s. In India, in the 1950s for example, 50 % came from area expansion, but since 1960 80 % of all extra food has come from increased yields (SARMA, 1978). Fallow reduction has not been of much significance, largely because population densities were already very high in 1950 and farming systems with a fallow only survived in the remoter and more sparsely populated areas. However, unlike Africa or Latin America, multiple cropping has contributed to extra food output. Multiple cropping was already widely practiced in Asia in 1950, and the ratios have increased since, although it is difficult to estimate their role in increasing

food output. It has certainly been of major importance in Malaysia,whilst one estimate suggests that 40 % of the increased rice output in China between 1949 and 1975 can be attributed to the increased area double and even triple cropped (LEEMING, 1979).

But much or indeed the majoritiy of increased food output in Asia has come from higher yields, as indeed was inevitable, for in 1950 Asia was already densely populated and the potential arable land is limited. There is no need to rehearse the progress of the Green Revolution in Asia. Whatever its social consequences, it has substantially increased wheat and rice yields in many parts of Asia, although it should be recalled that yields were increasing before 1965. In 1970s higher yields contributed two thirds of the extra food output in South West Asia, and three quarters in South and South East Asia (FAO, 1980).

5. Conclusions

Most discussions of the growth of food output in the nineteenth century or in the developing world today emphasise the role of increased crop yields. This paper suggests that historically this has been less important than is commonly assumed, and that in Latin America and Africa increased areas have been the prime source of extra output over the last forty years. The experience of Western Europe - and also the other developed countries - suggests that over time the role of area expansion diminishes and the importance of crop yield increases rises.This in turn can be related to differences in population density. As long as agricultural population densities are low, extra output comes from the expansion of the arable area, as exemplified by Europe before and during the nineteenth century. As the potential arable area diminishes, farmers turn to reduce the fallow period, a feature of most agricultural systems before 1800, and still important in Africa. Finally, and often at the same time as the reduction of fallow, crop yields are increased by the greater application of labour. This bears out the arguments of Ester BOSERUP, although not however in the developed countries since 1900, where agricultural populations have been declining.

L I T E R A T U R E

1. BOURKE, P.M.A., The Use of the Potato in Pre-famine Ireland. Journal of the Statistical and Social Inquiry Society of Ireland, Vol. 21, 1967-68.

2. DRAKE, M., Population and Society in Norway 1745-1865. 1969.

3. FAO, The State of Food and Agriculture 1980, Rome 1980, pp. 6-16.

4. GRIGG, D., The World Food Problem 1950-1980, London, 1985.

5. LEEMING, F., Progress Toward Triple Cropping in China. Asian Survey, Vol. 19, 1979, pp.450-67.

6. MINGAY, G.E. and J.D. CHAMBERS, The Agricultural Revolution.

7. SARMA, J.S., India - a Drive Towards Self-sufficiency in Food Grains. American Journal of Agricultural Economics, Vol. 60, 1978, pp 859-64.

8. SIMON, J.L., Resources, Population and Environment: an Oversupply of False, Bad News. Science, Vol. 208, 1980, pp. 1431-7.

9. STERN, R.M., A Century of Food Exports. Kyklos, Vol. 13, 1960, pp. 44-64.

10. TOUTAIN, J.C., La Consommation Alimentaire en France de 1789 a 1964. Paris, 1971.

11. VANDENBROEKE, C., Cultivation and Consumption of the Potato in the 17th and 18th Centuries. Acta Historia Neerlandice, 5, 1971, pp. 15-39.

12. WALKER, K.R., China's Grain Production 1975-76 and 1952-7: Some Basic Statistics. China Quarterly, 86, 1981, pp. 215-47.

13. WEBER, A. and E. WEBER, The Structure of World Protein Consumption and Future Nitrogen Requirements. European Review of Agricultural Economics, Vol. 2, 1974-5, pp. 169-92.