

Eating in 2000 AD—meat and two veg or stones into bread?

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Probably there has never been a time when so many people in the whole world have eaten so well. The vast majority in the UK are numbered among them. We fortunate people have a more than adequate intake of food and drink and the harvests of many countries of the world make their contributions to our tables and, let it be added, not only at harvest time but almost continuously throughout the year. As far as we are concerned the situation is very pleasant and satisfying—in more ways than one. It has to be stressed, of course, that this happy state of affairs is the lot of only a limited number of countries. Broadly speaking, the area comprises all of Europe (both West and East but with some reservations about parts of eastern Europe, especially Poland), North America, Australia and New Zealand. In the Brandt Report (Brandt, 1980) the area is designated as 'the North'.

In the rest of the world, lumped together in the Brandt Report (Brandt, 1980) as 'the South', things are different. The level of difference varies widely but in the majority of countries large sections of the population are frequently short of food at certain times of the year with consequential hardship and danger to health, especially among the vulnerable groups, i.e. children, pregnant women and nursing mothers. There are in such societies relatively few old people as we understand the term.

In the present paper, I am not concerned with the social morality of that situation but it is worth noting that most of the concern for the hungry sections of the world's population comes from the countries of the North and not from the governments of the countries in the South. If you are generous-minded you will explain the apparent lack of concern by saying that the governments of these countries have even larger issues to deal with. If, however, you are cynical—and I have found it easy to become so after living for long periods in such countries—you may think that other factors also play a part. Whatever explanation you favour, the fact must be faced that a problem of real hunger exists for very many people and it stubbornly refuses to go away.

In the UK we have access to a lot of information on just how much food is consumed by family groups. The best source is the National Food Survey of household food consumption published quarterly (Ministry of Agriculture, Fisheries and Food, 1983). The figures for the second quarter of 1982 show that the average expenditure on food bought for consumption in the home was £8.34 per person per week or about £25 for a family of two adults and two children. Table 1 shows the nutritional value of household food as a percentage of the recommended intakes. Rather surprisingly the figures show a shortfall of energy intake but, with the exception of iron, intake of nutrients is generally above the recommended levels.

Table 1. *Nutritional value of household food as a percentage of recommended intakes (Department of Health and Social Security, 1979)**

	National averages			Families with two or more adults and three or more children		
	April– June 1981	Jan– March 1982	April– June 1982	April– June 1981	Jan– March 1982	April– June 1982
Energy	97	94	95	88	83	82
Protein	125	121	122	105	103	103
Calcium	173	166	170	140	132	133
Iron	99	97	99	87	81	85
Thiamin	123	121	123	115	108	112
Riboflavin	134	123	122	118	112	110
Nicotinic acid equivalent	182	176	177	158	158	157
Vitamin C	196	162	205	160	132	162
Vitamin A (retinol equivalent)	185	201	193	167	164	162

*All values make allowances for wastage in the home of 10% of the edible portion of food acquired, and for expected losses of nutrients during cooking. The percentages do not take into account the contributions made to dietary intake by sweets, soft drinks, alcohol and some outside snacks, but they include allowances for meals out.

The infrastructure which supports all this good eating in the UK and elsewhere has not just happened. It is the result of heavy investment by government and private agencies in agriculture and in the food processing industry. It involves not only the provision of finance but also technology and technical education.

As far as the raw food commodities produced in this country are concerned (mainly cereals, root crops, animal products and some vegetables) it is easy for those not directly involved to be ignorant of the extent of this investment. The Ministry of Agriculture, Fisheries and Food (1983) stated that the planned expenditure in the current year (1984) will be £2256 million. While some of that cost relates to payments for commodities sold into intervention in accordance with EEC agreements, most of it is directly underpinning the agricultural industry of this country. To that amount must be added the vast sum invested by farmers in the UK in their land, equipment, supplies, maintenance and labour. Almost all of the commodities grown on the land, however, need some form of processing, thus giving rise to a large and efficient food processing industry. This industry also converts imported raw food materials into commodities such as edible oils, refined sugar, some meat products, chocolate products and instant coffee. Thus, growing food crops or rearing animals for food purposes and processing them is an extensive and expensive high technology enterprise and one which makes heavy demands on global resources, including energy resources.

The first thing to be said about the South is that there is far less accurate information on agricultural production, food intake and the nutritional status of different population groups. As far as food intake is concerned there are some

results available from small surveys on groups of homes and on institutional catering in schools and colleges but these are hardly representative. All we can do is attempt to build up a picture in broad outline of what the food supply position is in different parts of the world and how many people are likely to consume it. This can be done from estimates of the main staple foods produced and from demographic information, together with trade figures for the import and export of food commodities.

These sources combine to present a disquieting picture but, before we allow our indignation to run riot, it is worth noting that food shortages and multiple deaths from famine are nothing new in history. Hunger and famine have always been spectres haunting the minds of men. Table 2 is therefore of interest.

Table 2. *Authenticated world famines (Open University, 1978)*

436 BC	Rome	Thousands of people threw themselves into the Tiber
310 AD	England	40 000 deaths
917-18	India	Great mortality in Kashmir
c. 1051	Mexico	Migration of Toltecs
1064-72	Egypt	7 year failure of Nile flood and cannibalism reported
1069	England	Harrying by Norsemen; cannibalism reported
1344-45	India	Many thousand deaths
1347	Italy	Famine followed by plague, great mortality
1594-98	Asia	In India great mortality, cannibalism
1600	Russia	500 000 deaths from famine and plague
1630	Deccan, India	30 000 deaths in Surat alone
1660-61	India	No rain for 2 years
1667	India	Excessive rain and great mortality (Hyderabad)
1769	France	5% of total population reported to have died
1769-70	India	10 million deaths due to drought in Bengal
1770	Eastern Europe	Famine and disease caused 168,000 deaths in Bohemia and 20 000 in Russia and Poland
1775	Cape Verde Islands	16 000 deaths
1790-92	India	Great mortality in Bombay and Hyderabad
1803-04	Western India	Due to drought, locusts and war thousands died
1837-38	North-western India	800 000 deaths
1846-47	Ireland	Potato blight, 2-3 million deaths
1866	India	1 million deaths in Bengal and Orissa
1869	India	1.5 million deaths in Rajputana
1874-75	Asia Minor	150 000 deaths
1876-78	India	5 million deaths
1876-79	Northern China	Almost no rain for 3 years; deaths estimated at 9-13 million
1891-92	Russia	Widespread distress but mortality small
1899-1900	India	1 million deaths
1918-19	Uganda	4400 deaths
1920-21	Northern China	500 000 deaths
1920-21	Russia	Due to drought, millions died
1929	Hunan, China	2 million deaths
1932-33	Russia	Due to collectivization; excess mortality estimated at 3-10 million
1943-44	Bengal, India	Excessive rain and wartime difficulty of supply; 2-4 million deaths
1943	Ruanda-Urandi	35 000-50 000 deaths
1968-70	Biafra	Due to civil war several hundred thousand deaths (minimum)

Deaths from hunger, almost certainly associated with hypothermia, were not unknown in Scotland as late as the seventeenth century. For example, the Burgh Records of Aberdeen (1871) have an entry dated August 1634 which reads as follows: 'The inhabitants of Caithness and Orkney are in great distress and misery through famine . . . multitudes die in open fields and there is none to bury them . . . some run to the sea and drown themselves. This is due to tempestuous and bitter weather from the ocean.'

World production of food has probably been continuously increasing since very early times but so also has the number of people waiting to consume it. The indices of production for recent years are given in Table 3. In the period 1976–80 there has been a significant increase in global food production. However, as far as the developing countries are concerned population growth has largely neutralized this increase in terms of *per capita* availability. Indeed, in both the African countries and the Caribbean there is now less food available per person than there was 15 years ago.

The import of food commodities also has a bearing on food availability and in Table 4 the indices of the volume of imports of agricultural and fishery products are set out for the developing countries as a whole and for Africa in particular.

Table 3. *Indices of food production (FAO, 1982, p. 126)*

	1969–71 = 100									
	Total					<i>Per capita</i>				
	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980
Global	116	119	124	125	125	104	105	107	106	104
Developed countries	113	116	120	120	119	108	110	113	112	110
Developing countries:										
Africa	111	109	113	114	119	94	90	90	88	89
(Nigeria)	(103)	107	111	121	126)	(90	88	87	86	88)
Caribbean	106	108	117	118	112	94	94	100	99	92
(Jamaica)	(106	104	114	111	109)	(95	92	100	96	93)
South Asia	113	112	126	120	126	98	104	104	97	99
(Pakistan)	(121	126	127	134	138)	(101	102	100	101	101)
(Bangladesh)	(103	112	116	112	126)	(90	94	95	89	97)

Table 4. *Indices of volume of imports of agricultural and fishery products (FAO, 1982, p. 156)*

	1969–71 = 100										
	1961–65	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Developing countries											
Food	79	106	109	124	135	133	140	165	189	207	243
Fishery	77	107	109	104	112	123	127	124	138	150	144
Africa											
Food	80	113	113	119	131	131	138	178	210	213	245
Fishery	99	109	125	136	157	151	193	194	227	251	257

The figures show a significant increase in the amount of food imported by the developing countries—almost $2\frac{1}{2}$ times. The imports of fishery products have also increased. In Africa the imports of food are very similar to those of the developing world as a whole but the imports of fishery products are much higher. It is interesting to break down these very broad figures into cereal crops and fishery products and, for the African countries, to show these as actual quantities imported (Table 5).

By any standard these figures are remarkable: almost a fivefold increase in wheat, a tenfold increase in maize and a fourfold increase in rice imports. The increase in fish imports is about threefold. Such figures are most encouraging to nutritionists but both grain and fish are expensive imports. Although some supplies represent commodities coming in as part of international aid, vast sums of foreign currency are being used to augment food supplies which probably could be produced locally. Similar examples could be taken from other parts of the developing world. Karim (1980) points out that during the last two decades the rate of population growth in Bangladesh has exceeded the rate of agricultural development so producing a steadily worsening crisis. A similar situation exists in other countries of eastern Asia. Even in India, which has shown some remarkable increases in levels of production through Green Revolution techniques in the Punjab, there has been only limited overall improvement, although the policy of export of some food grains to other Asian countries has affected the position there. One large country which is a significant exception to this pattern is communist China. Some people may not like the country's political policies but in agriculture it presents a success story.

Now what exactly do we mean by saying that people are not getting enough to eat? We can get a reasonably good answer to that question by referring to the Food and Agriculture Organization's *Fourth World Food Survey* (FAO, 1977). In the words of the survey, 'persons with food intakes below 1.2 basal metabolic rate in all probability are forced to subsist on quantities of food insufficient to lead a full, healthy, well-developed and active life'. In short they are underfed. On that basis, Mazumdar (1980) calculated that the average daily *per capita* requirement in forty-six countries in Africa was 9.8 MJ (2336 kcal) while the supply was only 8.8 MJ (2110 kcal) or just about 90% of the requirement. In twenty-five of these

Table 5. *Volume of agricultural and fishery products imported to Africa (FAO, 1982, p. 132)*

	1000 tonnes										
	1961-65	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Wheat	1629	3337	3518	3821	4559	5145	5057	6077	7378	7235	8110
Maize	243	610	480	480	830	855	671	872	1155	1179	2520
Rice	577	844	796	983	986	602	878	1601	1816	1799	2166
Fish											
Fresh or frozen	66	155	196	234	315	305	294	290	346	409	413
Cured	94	63	53	50	40	46	52	41	38	43	43

countries where more detailed statistics are available, Mazumdar (1980) estimated that the percentage of underfed people varied between 8 and 10% in the Ivory Coast and Morocco to almost 50% in Chad, Mali and Mauretania. There are probably about ten million people underfed in both Ethiopia and Zaire. In addition to this food-energy gap, protein could also be in short supply.

All in all, it is a disquieting situation, but what kind of scenarios can be projected towards the year 2000? Quite a few have been published and they tend to be either discouraging or positively frightening. It is worth putting on record, however, that Poleman (1981) doubts if there really is a serious food problem. The Global 2000 Report to the United States President published in 1980, as summarized by Barney (1982), forecasts that a world population of 4100 million in 1975 will become 6350 million in the year 2000: 92% of the increase will be in the developing countries. The figure is of the same order as the FAO's (1982) estimate of 6100 million. It is further suggested that by the year 2000 food production will have increased by about 90%, mainly as a result of greater use of industrial energy and more intensive use of yield-enhancing inputs based on petroleum products. As a result, the cost of producing food will increase by 95% between 1975 and 2000. All this is based on the assumption that no climatic deterioration will take place, e.g. increase of drought, but account is taken of some increasing desertification. Even so, consumption levels for developing countries will scarcely improve. What the Report does not say is where the money to produce this extra food will come from. At current levels of income projected to the year 2000, there is no way that the majority of governments in developing countries, especially Africa and Asia, could buy the necessary inputs to produce it or import it. Nor, of course, is there much chance of most of the population being able to buy it once it had been produced. Here is the classic problem of the developing countries: 'economic development and the nutritional status of populations are inextricably linked' (Sahn & Scrimshaw, 1983).

A full discussion of the details of the scenario is outside the scope of this paper but various doubts arise. For example, how long can we expect the soils in the countries of the North to go on producing crops at the very high levels of the last two or three decades? To quote from the abstract of the US publication, *Foreign Affairs*, by Soth (1981): 'The problem of soil resource maintenance versus unrestrained grain exports is discussed. At the rate exports are increasing, the danger of permanent damage is becoming imminent. It is concluded that the provision of feed, fertilizer, technical assistance and applied research into the agriculture of the LDCs (less developed countries) would pay off better than exhausting the soil productivity of the USA in order to supply world demand.'

I can understand the concern expressed. There are, in fact, already thirteen centres funded internationally in different parts of the world engaged in research to improve food production in the developing countries.

Against this sombre background there are two broad generalizations which need to be made. The first is that when Boyd Orr (1950) drew attention to the world's food problem, there were about 2250 million people in the world. Since that time

the global population has risen enormously but mankind is still in business. There are still millions of hungry and underfed people in the world (far too many, you may think, if you have any social conscience) but we have not yet had the global disasters which some scientists so confidently predicted away back in the 1950s of millions of people dying of hunger.

The world today, especially in the countries of the South, is a much different place from the world Boyd Orr knew in terms of political, social and economic change. One quite unexpected change has been the growth in urbanization. Table 6 shows some of these changes as far as the countries of Africa are concerned. Thus, larger amounts of food are being produced by fewer people.

That leads on to the second generalization: the increase in the yield of cereal crops in the past two or three decades has come through agricultural developments such as the Green Revolution and there is no reason to believe that in the countries of the South such developments have reached their limit. It must be added, however, that there is a growing awareness that new agricultural technologies as well as new varieties of crops, new pesticides and so on have disadvantages as well

Table 6. *The population growth of major tropical African cities, 1955–75 (O'Connor, 1978)**

	Population ($\times 10^3$)				
	c. 1955	c. 1960	c. 1965	c. 1970	c. 1975
Ibadan	500	560	620	700	800
Addis Ababa	430	490	580	850	1100
Lagos	360	600	1000	1500	2000
Kinshasa	<i>349</i>	500	800	<i>1323</i>	2000
Accra	290	<i>388</i>	530	739	1000
Khartoum	<i>246</i>	350	500	700	900
Dakar	<i>231</i>	<i>375</i>	460	600	800
Salisbury	220	270	320	<i>386</i>	560
Nairobi	200	270	380	509	720
Luanda	180	<i>225</i>	300	<i>475</i>	—
Kano	180	230	300	400	—
Bulawayo	170	200	220	<i>246</i>	340
Lubumbashi	<i>143</i>	200	250	<i>318</i>	—
Kumasi	140	<i>218</i>	270	<i>345</i>	—
Maputo	130	<i>179</i>	250	<i>378</i>	—
Mombasa	130	170	210	<i>247</i>	340
Abidjan	<i>128</i>	220	340	550	900
Dar es Salaam	120	170	240	340	500
Kampala	110	160	240	330	—
Douala	110	150	200	280	—
Lusaka	70	100	150	<i>238</i>	430
Kananga	50	100	200	<i>429</i>	—

*The data are taken mainly from national sources, and have been estimated by extrapolation where figures are available only for other years. They are for the whole agglomeration rather than for the municipal area. Census figures are in italic.

as advantages. Indeed, there are some social scientists (e.g. Rafiq, 1979) who believe that the Green Revolution has done as much harm as good. The new techniques need an investment of both capital and know-how. As a result only the better-off farmers can take advantage of them. In contrast poor farmers with limited resources are sometimes forced to sell their land and become landless labourers: that has happened in some parts of Northern India. It would be foolish to ignore this social dilemma but without the Green Revolution world hunger would be greater than it now is.

Bearing in mind the points raised in the present paper, my own view is that it is possible to be cautiously optimistic that in the year 2000 the world will still be able to feed itself from conventional food sources, with this qualification: at about the same level as at present. That means many millions of hungry and underfed people in the world, a situation which few of us would willingly accept.

I see, therefore, a continuing and growing place for the development of novel sources of food. The recent re-issue by the Protein Advisory Group/International Union of Nutrition Societies (1983) of the revised guidelines for preclinical testing of novel sources of food is clear evidence that many people believe that non-conventional sources of food will make a contribution to the human diet in the future. However, I think some more fundamental upstream thinking is necessary in relation to both source material and economic factors. I made the point earlier that mankind as a whole is facing a food-energy gap. It is energy that is in short supply yet almost all the work in the field of novel sources of food has been done on the production of protein-rich material, e.g. utilization of 'waste' material from animals, products of the sea, leaf protein concentrate, bacterial products. No doubt protein is in short supply in the diet of the underfed millions of the world and, of course, such materials can be used as an energy source, but carbohydrate material would do, and it is likely to be a lot cheaper.

I must admit that I do not know how it is going to be done. Stones into bread would be fine but, as happened when the idea was first put forward, it has to be ruled out as impracticable. What we really need is some enzyme capable of working at a wide range of temperatures and pH values which would reverse the natural processes in the plant kingdom and degrade cellulose and lignin into simple sugars and then conveniently build these up into starches. An interesting thought, but no one would pretend that the necessary biochemistry is as yet on the horizon.

Equally formidable—and I use the word deliberately—are the economic factors. If novel foods are going to be used in the countries of the South, and that is certainly where the greatest need will be, then they must be low-priced in the market place as well as acceptable on cultural and religious grounds. As I understand such matters, that means low-cost raw materials, low processing costs and low-cost services, especially energy and water.

It would be possible to manufacture them in the countries of the North and transport them to where they will be used but it is hard to see this being done at a low price to the user. Very few governments in the developing countries would be willing to subsidise such products if past experience is any guide. On the other

hand, producing them in the countries where they were to be used would almost certainly need imported equipment and technical expertise.

The problem is a complex one and the development of novel sources of food will not be an easy task. I am glad that I will not be called on to face it!

REFERENCES

- Anon. (1980). *China: Agriculture in Review*, Market Commentary, Grains and Oilseeds, September, 36–43.
- Barney, G. E. (1982). *The Global 2000 Report*, vol. 1, p. 405. London: Penguin
- Boyd Orr, J. (1950). *Scientific American*, August.
- Brandt, W. (Chairman) (1980). *North-South: a Programme for Survival* Report of the Independent Commission on International Development Issues. Pan World Affairs.
- Burgh Records of Aberdeen (1871). 1625–1642 (edited 1871), pp. 67–69.
- Department of Health and Social Security (1979). *Recommended Daily Amounts of Food Energy and Nutrients for Groups of People in the UK*. London: H.M. Stationery Office.
- FAO (1977). *Fourth World Food Survey*. Rome: Food and Agriculture Organization.
- FAO (1982). *The State of Food and Agriculture 1981*. Rome: Food and Agriculture Organization.
- Karim, M. R. (1980). *The Food/Population Dilemma in Bangladesh*, pp. 161–193. Bangladesh Academy for Rural Development.
- Mazumdar, S. (1980). *Ceres* 13 (4), 36–40.
- Ministry of Agriculture, Fisheries and Food (1983). Statement by Minister, Rt Hon. Michael Jopling, House of Commons, London.
- Ministry of Agriculture, Fisheries and Food (1983). *National Food Survey 1982* (Second Quarter). London: H.M. Stationery Office.
- O'Connor, A. M. (1978). *The Geography of Tropical African Development*, 2nd ed., p. 177. Oxford: Pergamon Press.
- Open University (1978). *Food Production Systems*, unit 10, pp. 68–69. Milton Keynes: Open University.
- Poleman, T. T. (1981). *Food Policy* 6 (4), 236–252.
- Protein Advisory Group/International Union of Nutrition Societies (1983). *Human Testing of Novel Foods*. PAG/IUNS Revised Guidelines no. 7. (Quoted in *Food and Nutrition Bulletin* (1983), 5 (2) 77–80).
- Rafiq, N. (1979). The socio-economic implications and results of the Green Revolution. Dissertation, University of Hamburg.
- Sahn, D. E. & Scrimshaw, N. S. (1983). *Food and Nutrition Bulletin* 5 (1), 2–15.
- Soth, L. (1981). *Foreign Affairs* 59 (4), 895–912.