Proceedings of the Nutrition Society (2001), **60**, 215–220
DOI: 10.1079/PNS200088

The impact of globalisation, free trade and technology on food and nutrition in the new millennium

Philip McMichael
Department of Rural Sociology, 117 Warren Hall, Cornell University, Ithaca, NY 14853–7801, USA

The millennium promises a dramatic politicisation of the food question. In addition to the prominent issues of food security, hunger and nutrition, bioengineering, food safety and quality, there are related issues of environmental sustainability, power, sovereignty and rights. All these issues are deeply implicated in the current corporate form of globalisation, which is transforming historic global arrangements by subordinating public institutions and the question of food security to private solutions. The present paper questions the self-evident association between globalisation and nutritional improvement.

Globalisation: Food security: Nutritional improvement

One apparent index of globalisation is the brisk and growing trade in foodstuffs supplying affluent populations with exotic high-value and all-seasonal foods via corporate global sourcing arrangements. However, only about 20 % of the world's six billion population participate in the cash or consumer credit economy, and about 90 % of the world's food consumption occurs where it is produced. While urbanites depend on the market for almost all their food consumption, rural populations consume 60 % of the food they produce (AF McCalla, unpublished results). There is a big discrepancy between the image and affluent experience of globalisation, and global reality. It is this discrepancy that shapes the politics of globalisation.

The existence of hunger on a global scale is a source of legitimacy for large food and biotechnology firms in promoting private solutions to development. Monsanto Corporation's home page on the web has proclaimed: 'Guess Who's Coming to Dinner? 10 billion by 2030'. It warns that 'low-tech' agriculture 'will not produce sufficient crop yield increases and improvements to feed the world's burgeoning population', declaring that 'biotechnology innovations will triple crop yields without requiring any additional farmland, saving valuable rainforests and animal habitats' and that 'biotechnology can feed the world…let the harvest begin' (Kimbrell, 1998). These statements presume an easy inevitability to global integration via a market-driven paradigm, constituting the only approach to addressing hunger.

The present paper criticises the terms in which food insecurity is being defined. In the aftermath of the 'era of development' in which nations were responsible for managing economic growth, including managing food security via green revolution technologies, development is now defined as a necessary global project in which international institutions and firms are increasingly responsible for managing economic growth, including managing food security as a global problem with global solutions via biotechnologies.

While globalisation is presented as an inevitable realisation of Western market rationality, it is busy revealing its limitations across the world. The finite nature of resources (renewable and/or non-renewable) and the seemingly infinite articulations of cultural alternatives to the market culture may appear as 'external' limits to globalisation, but they are in fact powerful internal contradictions. These alternatives actually constitute globalisation as a contradictory project, because resistance movements represent and express the material and discursive conditions that the market regime seeks to appropriate. While resistance takes a variety of forms, it collectively calls into question the development paradigm's view of nature as an unproblematic human laboratory, separating food from ecology and culture as a commodified input for urban diets and industrial processing, and residualising rural society as a source of labour and natural resources for industrial society.

Abbreviations: IFPRI, International Food Policy and Research Institute; TRIPs, trade-related intellectual property rights.
Corresponding author: Professor P. McMichael, fax +1 607 254 2896, email pdm1@cornell.edu

The present paper examines the food question, then, as a window on the politics of globalisation, but deeply rooted in the relationship between modernity and dietary reconstruction.

Social diets and the world historical dimensions of food

Food embodies world history like no other substance. There are many threads in this story, but perhaps the most symbolic is that of the cattle culture and its dramatic transformation of ecologies and diets on a world scale. The introduction of the European cattle culture to the 'New World' was a forerunner of an agribusiness complex that now links specialised soyabean producers, maize farmers, and lot-fed cattle across the world. The global cattle complex binds the world into an animal protein dependency that imposes feed grain and livestock monocultures on local ecologies and competes with the direct consumption of cereals.

The trajectory of the beef industry follows the contours of modernisation. By the mid-twentieth century, mass consumption subdivided the beef industry into lot-fed high-value beef cuts, and grass-fed cattle supplying the cheaper lean meat for the global fast-food industry. In the early post-second World War development era commercial beef was consumed largely in developed countries, via a specialised livestock industry increasingly sourced by soyabean and hybrid maize inputs as feed, while in the developing countries livestock combined with crops in mixed farming systems. The fast food industry in the developed countries depended on grass-fed cattle, and its proliferation from the 1960s produced the so-called 'world steer', as a global archetype of modernising food relationships, distributed across developed and developing regions, most notably in Central America, where cattle populations rose from $4{\cdot}2 \times 10^6$ to $9{\cdot}6 \times 10^6$ from 1950 (Delgado *et al*. 1999).

The world steer is a global artefact; animal health and growth depend on a global supply of medicines, antibiotics, chemical fertilizers and herbicides by trans-national firms. However, the specialisation of world steer production is the antithesis of traditional mixed farming systems in developing countries. Sponsored by the World Bank and regional development banks, via governments encouraged to develop new agri-exports, the world steer industry hastened de-peasantisation. Development policies favouring foreign cattle breeds over the native 'criollo' have undermined traditional cattle raising and local self-provisioning. Peasants forfeit their original meat and milk supplies and side products such as tallow for cooking oil and leather for clothing and footwear (Sanderson, 1986). In short, the world steer caters to affluent global consumers at the same time that it undermines local agro-ecologies.

As societies in some developing countries developed sizeable middle classes with Westernised diets, specialised domestic livestock industries have mushroomed alongside traditional farming systems. Between the early 1970s and the mid-1990s, meat consumption in the southern hemisphere grew by 70×10^6 t, compared with a growth rate of 26×10^6 t in the northern hemisphere. 'In 1983 developing countries consumed 36 percent of all meat and 34 percent of all milk consumed worldwide. By 1993 those percentages had risen to 48 percent and 41 percent, respectively' (Delgado *et al*. 1999). Nevertheless, the International Food Policy Research Institute (IFPRI) estimates that traditional low-intensity livestock production methods remain throughout the world on about 26 % of the land area, supplying about 50 % of the meat, and states that the 'integration of livestock and crop operations is still the main avenue for sustainable intensification of agriculture in many regions of the world' (Delgado *et al*. 1999).

IFPRI (Delgado *et al*. 1999) reports that the world is in the early phase of a demand-led 'livestock revolution' distinguished from the supply-led green revolution. In other words, the livestock revolution expresses globalisation, insofar as it caters to a world market anchored in a relatively affluent consumer segment of the world's population. A 'demand-led livestock revolution' is an implicit reference to the shift towards the market as organising principle, which influences much that is described in the report. Thus, the authors observe with respect to public health: 'Unfortunately, government services are being curtailed in this area in many poor countries as the size of the overall public sector is being reduced'; they note that 'escalating demand for animal products leads to animal concentrations that are out of balance with the waste absorption and feed supply capacity of available land', that as 'livestock consumption increases there is considerable interest in how the poor can retain their market share of livestock production', and that feedcrops 'have the potential to cause greater environmental damage than other crops'.

Aside from these disclaimers the overall tenor of the report is upbeat, observing that livestock products 'are an appealing and convenient nutrient source' and that livestock production 'is an especially important source of income for the rural poor in developing countries' (Delgado *et al*. 1999). However, when answering the claim that affluent consumers of livestock will bid away the foodstuffs of the poor through the market, the report argues that cereals prices will remain stable and that 'The Livestock Revolution's effect on the food security of poor people, through cereal prices, is likely to be far less important than its effect on the income of the poor' (Delgado *et al*. 1999). However, the question of the income of the poor is moot, because the livestock revolution is not simply a quantitative expansion of livestock production and livestock products raising incomes of livestock owners, rather it will transform the conditions of farming across the world. If the income of the poor increases, it will be by leaving mixed farming to specialise in livestock, and becoming contract farmers for food corporations in precarious dependency on distant markets and prices.

The IFPRI report (Delgado *et al*. 1999) never problematises the 'livestock revolution' as a policy choice, rather it argues that 'the structural shift in developing-country diets toward animal protein is a given that must be dealt with', even though elsewhere IFPRI reports that one trend in the livestock revolution is 'an ongoing change in the status of livestock production from a small-scale local activity to a global activity' (Pinstrup-Andersen *et al*. 1999). The substitution of global monocultures for local agricultural diversity commits the fallacy of fetishising rising crop

yields and discounting the costs. As the International Movement for Ecological Agriculture observed: 'if one takes into account the hidden costs on input subsidies and nonrenewable resources, and the costs of ecological damage (leading to lower yields after some time) and furthermore, measure yield against high fertilizer and water costs, then the green revolution techniques are highly inefficient. . . .Even more seriously, the green revolution measurement of output is flawed because it only accounts for a single crop (e.g. rice) and even then only a single component of that crop (e.g. grain) whilst neglecting the uses of straw for fodder and fertilizer. Thus, it neglects to take into account that there were many other biological resources. . . .within the same land in the traditional system that were reduced or wiped out with the green revolution' (see Fox, 2000).

These shifts are presaged in the parallel transformation of food security conditions. While noting the importance of roots and tubers as a principal source of food for poor farmers around the world, and noting the recent increased production of potatoes and yams in particular, IFPRI reports that a 'rapid expansion in the demand for roots and tubers for livestock feed has been under way for some time, particularly in Asia, and is likely to continue as demand for meat products grows rapidly in coming years.' Meanwhile, IFPRI predicts that demand for maize in the southern hemisphere 'will overtake demand for rice and wheat' and about '64 percent of the maize demand will go toward feeding livestock compared with 8 percent of wheat and 3 percent of rice in 2020' (Pinstrup-Andersen *et al*. 1999). During the 1990s, while food cereals production remained the same in Brazil and China, feed cereals production almost doubled in each case (Food and Agriculture Organization, 2000). Rising animal protein consumption is perhaps the key indicator of the 'nutrition transition', involving a declining consumption of cereals and legumes, and a rising consumption of meat and dairy fats, salt and sugars (Lang *et al*. 1999).

The nutrition transition has a political history framed by class, cultural and imperial relationships. Animal protein consumption signals rising affluence and emulation of Western diets, both of which are not so much inevitable as the historical product of Western developmentalism (see McMichael, 2000). Ironically, the southern hemisphere is condemned to repeat the trajectory of the modernising northern-hemisphere diet, just as health-conscious affluent northern-hemisphere consumers are reappropriating southern-hemisphere diets. In a report on the occasion of the World Bank's $93·5 million loan to China for 130 feedlots and five beef processing centres for its nascent beef industry, in 1999, Neal Barnard, president of the Physicians' Committee for Responsible Medicine, observed: 'While smart Americans recognize the need to "Easternize" their own diets with rice, soy products and more vegetarian options, World Bank bureaucrats decided to promote a Westernization of China's diet. Instead of supporting the use of grain as a cholesterol-free dietary staple for people, the grain will be fed to cattle to produce meat. Of course the World Bank's efforts to promote cattle farming in China are concerned less with good health than with economic investment. No doubt some cattle ranchers will profit as they edge out vegetable and rice acreage. But why is the World Bank, so roundly criticized for years over its self-defeating economic development schemes, falling into the same old trap?' (see mritchie@mail.iatp.org, 28 December 1999).

Dietary commodification has been integral to the expanded reproduction of the market culture and the ideology of 'development'. However, this role is double-edged, since its singular logic undermines non-capitalist food cultures, adulterates distinctive capitalist food cultures via 'McDonaldization' and genetically-modified organisms, and incubates serious epidemics of diet-related cancers, obesity and similar diseases. It is now common to refer to a 'global epidemic of malnutrition', in which the 1·2 billion underfed are matched by the 1·2 billion overfed. Furthermore, these paradoxical outcomes dramatise the perverse politics of food.

Agribusiness in the World Trade Organization regime

The redefinition of food security as a global problem waiting to be solved is rooted in the politics of liberalisation (McMichael, 2000). The 1984 Uruguay Round initiated the liberalisation of agriculture, when the Cairns Group of agri-exporters and a powerful agribusiness lobby pressed for agricultural reforms in the General Agreement on Tariffs and Trade (the US proposal was drafted by the former senior vice president of Cargill, which shares 50 % of US grain exports with Continental). Reforms included reductions in trade protection, farm subsidies and government intervention. Free trade was the ostensible demand, but the USA was also interested in an informal mercantilism based in consolidating its role as 'breadbasket of the world'. The ideological justification was provided by the USA in its challenge to the General Agreement on Tariffs and Trade agricultural protectionism: 'The U.S. has always maintained that self-sufficiency and food security are not one and the same. Food security – the ability to acquire the food you need when you need it – is best provided through a smooth-functioning world market' (see Ritchie, 1993).

Liberalisation General Agreement on Tariffs and Trade-style resulted in the 1994 World Trade Organization Agriculture Agreement to open agricultural markets by adopting minimum import requirements and tariff and producer subsidy reductions. The ultimate goal was to open markets for northern-hemisphere products, reflecting the strengthened position of the Organization for Economic Cooperation and Development countries in the international division of labour in agriculture. In 1990 90 % of the global seed market was controlled by the Organization for Economic Cooperation and Development countries. From 1970 to 1996, the Organization for Economic Cooperation and Development share in the volume of world cereal exports rose from 73 % to 82 %; the USA remained the world's major exporter of commercial crops such as maize, soyabean and wheat; the share of Africa, Latin America and Asia in world cereal imports increased to about 60 % (Pistorius & van Wijk, 1999). A neo-liberal regime would serve to consolidate this international division of labour. North American Free Trade Agreement is a case in point: quotas on duty-free US maize, wheat and rice imports into

https://doi.org/10.1079/PNS200088 Published online by Cambridge University Press

Mexico are being lowered in stages. In Mexico, 2·5 million households engage in rain-fed maize production, with a productivity differential of 2–3 US tons/ha compared with 7·5 US tons/ha in the American mid-West. With an estimate of a 200 % rise in maize imports under full implementation of the North American Free Trade Agreement by 2008, it is expected that more than two-thirds of Mexican maize production will not survive the competition (Watkins, 1996).

Pressures to deregulate northern-hemisphere farm sectors and to open southern-hemisphere agricultural regions to the world market involve a universal challenge to national economic institutions by trans-national firms, even though the EU and the USA have found ways to subvert agricultural liberalisation through export subsidies and deficiency payments to farmers. Global access by transnational corporations allows them to exploit the asymmetry between northern and southern hemispheres (e.g. the average subsidy to US farmers and grain traders is about 100 times the income of a maize farmer in Mindanao, Mexico), moving to undercut northern-hemisphere entitlement structures and their institutional supports by optimising global sourcing strategies (Watkins, 1996). At the same time, 80 % of farm subsidies in the Organization for Economic Cooperation and Development countries concentrate on the largest 20 % of (corporate) farmers, rendering small farmers increasingly vulnerable to the vicissitudes of a deregulated (and increasingly privately managed) global market for agricultural products. In 1994, 50 % of US farm products came from 2 % of the farms, and only 9 % from 73 % of the farms (Lehman & Krebs, 1996). In 1999 200 000 European farmers and 600 000 beef producers left the land; UK farm income has fallen by about 75 % since 1998, driving 20 000 farmers out of business; US farm income declined by about 50 % between 1996 and 1999 (Gorelick, 2000). Under these conditions, agriculture becomes less and less a foundational institution of societies and states, and more and more a tenuous component of corporate global sourcing strategies.

Agriculture constitutes 65 % of the global economy, and corporate centralisation is unsurprising: 'the top ten agrochemical companies control 81 percent of the $29 billion global agrochemical market. Ten life science companies control 37 percent of the $15 billion per year global seed market. The world's ten major pharmaceutical companies control 47 percent of the $197 billion pharmaceutical market. Ten global firms now control 43 percent of the $15 billion veterinary pharmaceutical trade' and combined sales of ten trans-national food and beverage companies exceeded $211 billion in 1995 (Rifkin, 1998). Corporate control of the food system is achieved through vertical integration; from seeds, fertilisers, and equipment, to processing, transporting and marketing. The five largest 'gene giants' (AstraZeneca, DuPont, Monsanto, Novartis and Aventis) account for 60 % of the global pesticide market, 23 % of the global seed market and about 100 % of the transgenic seed market (ActionAid, 2000; Gorelick, 2000).

Bioengineering is currently transforming the crop development industry, accelerating the concentration and centralisation of agri-chemical corporations. Part of this integration process has been described as 'food chain clustering', whereby the gene giants form strategic alliances with agribusiness firms, allowing the firms with transgenic interests access to production. One such cluster is the Cargill/Monsanto joint venture; Cargill joins its extensive seed capacity with Monsanto's biotechnology and new genetic products, and Cargill recently acquired Continental Grain, meaning that Cargill 'would control more than 40 percent of all U.S. corn exports, a third of all soybeans exports and at least 20 percent of wheat exports' (Heffernan, 1999). Such 'crop development conglomerates' consist of networks of enterprises geared to developing specific genetic crops (see Pistorius & van Wijk, 1999).

The crop development industry has been exploring new markets in the post-green revolution southern hemisphere, where seed demand has increased by more than 30 % in Asia, and almost tripled in Africa, between 1980 and 1994. Expanding consumption of pasta, bread and meat in cities drives an expanding production of wheat and soyabean varieties, while the livestock revolution involves a rising demand for maize and soyabean varieties (Pistorius & van Wijk, 1999). While in 1999 most of the 34×10^6 ha of genetically-modified crops were grown in the northern hemisphere, by 2002 it is estimated that 550×10^6 ha of a world total of 900 million ha will be grown in the southern hemisphere (ActionAid, 2000).

In Asia three companies (Cargill, Pioneer and DeKalb) currently control about 70 % of the seed market, supplying hybrid seed for 25 % of the total maize area (although DeKalb and Cargill Seeds have recently been acquired by Monsanto), and Novartis is entering the maize seed business and establishing alliances with local Filipino companies like Cornworld (BIOTHAI, GRAIN, MASIPAG and PAN Indonesia, 1999). One of the emergent areas of crop development, Bt maize (a genetically-modified maize with a gene for an insect-killing toxin isolated from the soil microbe *Bacillus thuringiensis*) is likely to be the first transgenic maize to enter the Southeast Asian market. Monsanto is conducting Bt maize tests in Thailand, Indonesia (along with Pioneer), and plans to in the Philippines. The introduction of Bt maize may seriously prejudice a staple crop widely used in Asia for 400 years, and continuing in those areas untouched by the hybrid maize introduced by the green revolution.

In Southeast Asia about 40 % of the maize area is planted in farmers' varieties where the seed replacement rate is as low as 4 %, such as in Indonesia. Small farmers typically intercrop maize with other crops such as groundnut, mungbean, cowpea, soyabean, other pulses, cassava, sweet potatoes or vegetables (constituting 69 % of Indonesia's maize area and about 50 % of the upland maize areas of the Philippines). Nevertheless, the promotion of hybrids by governments and firms since the green revolution encroaches on farmer varieties; 60 % of Thailand's maize area in 1997 was occupied by hybrids, expected to rise to 70–75 % by 2000, and in Vietnam hybrid maize is expected to double soon to reach 80–90 % of the maize area. Meanwhile, Monsanto plans to apply Bt maize in Southeast Asia in 2001, and its current research and development portfolio focuses on the feed and processing industries, rather than promoting maize as a staple. Since the seed suppliers and grain processors are the same corporate complex, commercial farmers will have no control over prices, and

will bear the risks (BIOTHAI, GRAIN, MASIPAG and PAN Indonesia, 1999). The combined effect of market liberalisation, flooding the region with cheap grains, and the integration of crop development conglomerates, seriously threatens the biodiverse system of intercropping of farmer varieties.

Recent research discloses a total of 132 genetic patents on crops that evolved in the southern hemisphere but which are now grown worldwide (sixty-eight for maize genes, seventeen for potato, twenty-five for soyabean and twenty-two for wheat), indicating that staple foods are increasingly targeted for corporate patenting (ActionAid, 2000). Resistance to the biotechnology industry is gathering momentum across the world. In 1993 the ten million strong Karnataka Farmers Association in Bangalore demonstrated against Cargill Seeds for its plans to patent local germplasm and gain monopoly rights to its use. Through the 1990s, tens of thousands of Indian farmers demonstrated in Delhi against 'gene theft' and proposals to establish an intellectual property rights regime, to be regulated by the World Trade Organization (Kingsnorth, 1999).

This controversy over genetic heritage and property rights is deeply symbolic of globalisation, understood as a set of political relationships with historical roots in colonialism. The movement against biopiracy challenges the notion of gene patenting as a universal standard of scientific practice and private rights, and its discounting of traditional knowledges and sustainable agricultural and cultural practices. The intellectual property rights regime draws its legitimacy or efficacy from a synthesis of European and US patent laws, and their claims to protect and promote innovation. The trade-related intellectual property rights (TRIPs) agreement requires states to establish protection of biological resources either through patenting or an effective *sui generis* system, which expresses the 1992 Convention on Biological Diversity confirming national sovereignty over genetic resources.

The *sui generis* system for plants constitutes an alternative to patent protection, in recognising and securing collective rights for agricultural and medicinal plant biodiversity. As Shiva (1997) has noted: 'Indigenous knowledge systems are by and large ecological, while the dominant model of scientific knowledge, characterized by reductionism and fragmentation, is not equipped to take the complexity of interrelationships in nature fully into account'.

The significance of the TRIPs protocol is that intellectual property rights on gene patenting privilege governments and corporations as legal entities, and disempower communities and farmers whose rights over traditional knowledge go unrecognized. A case in point is the 1998 patenting of Indian basmati rice by the Texas-based company RiceTec Inc., which sells 'Kasmati' rice and 'Texmati' rice as authentic basmati. In 2000, under popular pressure, the Indian government successfully challenged four of the twenty claims for this patent because the seeds and plants producing the grain derive from centuries of indigenous cultivation. Meanwhile, in Thailand hundreds of farmers staged their own protests against RiceTec, which was targeting jasmine rice, on which five million farm families depend (Greenfield, 1999). The irony is that TRIPs grew out of an attempt to stem intellectual property pirating of Western products (watches, compact discs, etc) in the south, and TRIPs appears now to sanction a reverse biological form of piracy on a disproportionate scale threatening livelihood, rather than commodity, rights.

The *sui generis* option in TRIPs has been successfully interpreted to resist and potentially subvert biopiracy. In 1996, the small Indian village of Pattuvam, in the southern state of Kerala, declared its absolute ownership over all genetic resources within its jurisdiction. This move to preempt corporate genetic prospecting is protected by the 73 rd amendment to the Indian Constitution, which mandates decentralisation of powers to village-level institutions. The initiative stemmed from a group of young villagers, disaffected with the Indian party system and committed to sustainable development. They came up with the idea of having the village youth document local plant species and crop cultivars growing within the village's boundaries (Alvares, 1997). By registering its biodiversity, in local names, the village has moved to claim collective ownership of genetic resources, deny the possibility of corporate patents applying to these resources, and reinterpret the *sui generis* option of TRIPS by removing 'property' from this intellectual rights relationship.

Conclusion

The present paper has attempted to question the self-evident association between globalisation and technology and nutritional foods in the new millennium, by arguing for an interpretation of globalisation as a political project geared to a corporate form of organisation of the world market. When the US Agricultural Secretary declared at the start of the Uruguay Round negotiations (1986): '(The) idea that developing countries should feed themselves is an anachronism from a bygone era. They could better ensure their food security by relying on US agricultural products, which are available, in most cases at much lower cost' (see Bello, 2000), he underlined the globalist vision of a World Trade Organization regime managing world hunger and US green power together. This vision has been institutionalised sufficiently to empower and embolden the corporate clusters that are busy playing chess with the world's biological resources. However, as the present paper has also argued, the corporate bid for control in the name of global food security is generating increasingly consequential resistance to the imposition of a market monoculture on a world of cultural and biological diversity. Globalisation may be represented as inevitable and self-evident, but the reality is profoundly ambiguous.

The recent development of golden, or vitamin A, rice with funds from the Rockefeller Foundation and the European Commission is as much an attempt to address global food security as it appears to be a public relations tool for the genetic engineering industry (GRAIN, 2000). This transgenic rice is being promoted as a solution to micronutrient deficiencies, a global health problem, and has been promised free to small farmers. Arguably, micronutrient deficiency was one consequence of the macronutrient focus of the green revolution and the reduction of dietary diversity through its genetic reductionism. Golden rice, like other

https://doi.org/10.1079/PNS200088 Published online by Cambridge University Press

genetically-modified crops, is more likely to be part of the problem than part of the solution.

References

ActionAid (2000) Crops and robbers. Biopiracy and the patenting of staple food crops. ActionAid. http://www.actionaid.org

Alvares C (1997) An Indian village bucks GATT over control of genetic resources. *Third World Resurgence* **84**, 11–12.

Bello W (2000) Does world trade need World Trade Organization? *Businessworld* 11 January issue.

BIOTHAI, GRAIN, MASIPAG and PAN Indonesia (1999) Whose agenda? The corporatee takeover of corn in SE Asia. http://www.grain.org/publications/reports/takeover.htm

Delgado C, Rosegrant M, Steinfeld H, Elui S & Courbois C (1999) *Livestock to 2020. The Next Food Revolution*. Washington, DC: IFPRI.

Food and Agriculture Organization (2000) FAO statistical tables 2000. http://www.apps.fao.org/page/collections?subset=agriculture

Fox MW (2000) More help or more harm? Genetically engineered crops and world hunger. Bioethics@hsus.org

Gorelick S (2000) Facing the farm crisis. *Ecologist* **30**, 28–32.

GRAIN (2000) Engineering solutions to malnutrition. http://www.grain.org/publications/reports/malnutrition.htm

Greenfield G (1999) The WTO, the world food system, and the politics of harmonised destruction. http://www.labournet.org/discuss/global/wto.html

Heffernan B (1999) Consolidation in the food and agriculture system. Report to the National Farmers Union, United States. http://www.nfu.org/whstudy.html

Kimbrell A (1998) Why biotechnology and high-tech agriculture cannot feed the world. *Ecologist* **28**, 294–298.

Kingsnorth P (1999) India cheers while Monsanto burns. *Ecologist* **29**, 9–11.

Lang TM, Heasman M & Pitt J (1999) Food, globalisation and a new public health agenda. International Forum on Globalisation, San Francisco. http://www.mydocuments/globalisation/whitepaper99fin.doc

Lehman K & Krebs A (1996) Control of the World's food supply. In *The Case Against the Global Economy*, pp. 122–130 [J Mander and E Goldsmith, editors]. San Francisco, CA: Sierra Club Books.

McMichael P (2000) *Development and Social Change: A Global Perspective*. Thousand Oaks, CA: Pine Forge Press.

Pinstrup-Andersen P, Pandya-Lorch R & Rosegrant MW (1999) *World Food Prospects: Critical Issues For the Early Twenty-First Century*. Washington, DC: IFPRI.

Pistorius R & van Wijk J (1999) *The Exploitation of Plant Genetic Information. Political Strategies in Crop Development*. Wallingford, Oxon: CABI Publishing.

Rifkin J (1998) *The Biotech Century. Harnessing the Gene and Remaking the World*. New York: Putnam.

Ritchie M (1993) *Breaking the Deadlock: The United States and Agricultural Policy in the Uruguay Round*. Minneapolis, MN: Institute for Agriculture and Trade Policy.

Sanderson S (1986) The emergence of the 'world steer:' internationalization and foreign domination in Latin American cattle production. In *Food, the State and International Political Economy*, pp. 123–148 [FL Tullis and WL Hollist, editors]. Lincoln, NE: University of Nebraska Press.

Shiva V (1997) *Biopiracy. The Plunder of Nature and Knowledge*. Boston, MA: South End Press.

Watkins K (1996) Free trade and farm fallacies. From the Uruguay Round to the World Food Summit. *Ecologist* **26**, 244–255.