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A TRANSITION FROM AGRICULTURE TO REGENERATIVE FOOD SYSTEMS

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As part of the larger transition to a post-fossil-fuel era, major transformations of industrial agriculture can be expected to occur. This is not only because industrial agriculture is a major source of the unsustainability of industrial societies, but because it is itself unsustainable. Development of the types of regenerative and sustainable food and fibre systems that are needed will involve: (1) a restructuring and decolonizing of industrial agriculture; (2) the maintenance and enhancement of indigenous and traditional food systems; and (3) conceptual and value shifts towards systems approaches, contextual analysis by levels, and the use of health models rather than economic/productivity models as the basic evaluative criteria.

A transition from current modes of industrial agricultural production to regenerative food and fibre systems is one of the key elements of sustainability. It is also part of the much larger transition of all societies to a post-fossil-fuel era. The magnitude of this latter transition ranks with the other great transitions—from hunting and gathering to agricultural to urban civilizations to modern industrial societies.[1] Each of these transitions has involved a basic restructuring of the interactions and relationships between natural systems, social systems and technological systems, something that dramatically affects both energy and resource use. Also, as in each previous transition, basic reconceptualization and restructuring of food systems are involved.[2]

As many studies have shown, modern industrial societies are now encountering various global constraints or limits. These 'collisions' threaten the life-supporting capabilities of the biosphere, which in turn threatens industrial societies. The same 'vicious circle' applies to industrial agriculture. How the unsustainability of industrial agriculture increases the unsustainability of industrial societies can be seen in four major areas of global constraints and/or threats.[3]

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Global constraints/threats

Linkages between fossil fuel use, agriculture, and global climate change

The ways in which the global use of fossil fuels leads to acid rain, ozone depletion, global warming etc have been widely reported. There has been much less discussion of the linkages of fossil fuel use to food and agriculture. The few specialized studies done on agriculture typically do not include fibre crops, nor production in the informal sector—such as household and community gardens.[4] More important, these studies do not include data on the complete *food system*—which, in addition to production, includes processing, distribution, storage, use and disposal. Food systems thus include social, health, symbolic, energy and many other facets.

While departments of agriculture and forestry are ubiquitous, I am not aware of any country, state, or city that has a ministry or department of food—something that reflects (and perhaps helps to explain) why we have neither organizations nor data sets on food systems.[5]

Some energy studies done in the 1970s did look at industrial food systems and highlighted their great energy inefficiency—in which some 10 calories of energy are required to deliver 1 food calorie on our dinner plates.[6] They also revealed that while the number of farmers in the industrial countries has declined dramatically since the turn of the century, the numbers employed in the total food system have remained fairly constant as food processors, distributors, retailers and restaurant workers have been added as farmers decreased. However, these studies also ignored much of the informal economy, giving us only a partial indication of the true size and importance of food and fibre systems. Thus, since much more fossil fuel is used in industrial food and fibre systems than most people are aware, improving their energy efficiency ought to be a major element in addressing global climate change issues.

Without this, the spread of industrial food and fibre production systems through green-revolution-type technologies will generate increasing amounts of greenhouse gases. In turn, this will have negative effects on industrial food and fibre production. Again, the few specialized studies that have been done tend to provide a misleading picture. Specific crops are studied and estimates given as to how average changes in temperature, moisture, and/or carbon dioxide concentrations will affect production. Some studies suggest which regions and countries might be winners or losers.

The larger picture is much more complex and disturbing. Crops are adapted to regionally specific weather patterns. Changes in the *variability* of the weather (something projected for the temperate zones) will be much more disruptive than the projected changes in the *averages*.[7] But what about the 'new' favourable climate zones that may emerge? Climate modellers have tended to ignore the tremendous amount of capital and human investment made in agriculture. For example, if the temperate zones 'move north', the US will face several dilemmas. One is that the Colorado River basin may dry up—leaving its dams as some sort of latter-day pyramids. Another is that it is unlikely that urban majorities will support the massive capital costs required for new dams and irrigation networks and for retraining farmers, extension personnel etc at a time when there will be huge demands for capital to protect coastal cities—whether through dykes or relocation—from rising sea levels.

At a more global level, there is little awareness that from the perspective of human ecology, the real energy problem is not a scarcity of energy, but too much energy forcibly being channelled through both natural and social systems—a process

that in general simplifies their structures, reduces their diversity, and makes them more vulnerable to collapse.[8] Thus, at all levels there are serious misunderstandings about the role and significance of fossil fuel use as it relates to agriculture and food.

The explosion of livestock and human populations

While the easy availability of fossil fuels has been a major factor in the population explosion of humans, it is modern agriculture and agribusiness that have facilitated a population explosion of livestock by catering to the meat preferences of people. If we include livestock populations in our demographics, we come up with rather different rankings of the most populous countries.[9] In terms of general pressures of populations on the environment, it is clear that livestock needs to be included. Also, as with humans, the resource use per animal and the type of resources used (edible by humans or not) need to be included.[10]

At a global scale, this explosion of livestock populations is a significant source of environmental destruction and degradation—leading to high levels of water pollution, soil erosion (for the grazing and/or feedgrains required), and deforestation.[11] These negative trends feed back into agriculture, reducing production through the same loss or degradation of soils and water. In addition, losses of biodiversity and of crop and animal germplasm increase the risks of production losses to pests and diseases.

The loss of cultural diversity and biodiversity

This affects much more than just food and fibre systems. As indicated above, the underlying source of these losses is the easy availability of fossil fuels which enables humans to channel so much energy through natural and social systems that they are either damaged or destroyed, or at a minimum, simplified as they are 'converted' or 'developed'. In industrial agriculture, the main crops are essentially species and habitats which are kept at a pioneer stage of ecological succession—at very high energy and environmental costs. Indigenous systems—which have demonstrated their sustainability over the centuries—are those which are complex and mimic the later stages of succession.

A more general simplification of cultures and social systems has accompanied industrial 'development'.[12] Visions of a 'global village' (whether electronic or otherwise) neglect the fundamental importance of cultural diversity, much less its links to biodiversity. A more appropriate image would be a 'globe of villages'—albeit with a healthy scattering of cities and states. Historically, crucial areas of biodiversity were seen to be sacred by indigenous peoples—something that reflected a realization that they were the *sources* of life.[13] In terms of crop germplasm, only a few anthropologists have explored the close linkages between cultural diversity and biodiversity—for example in the Peruvian highlands where different tribes cultivate different species of potatoes at different altitudes.[14]

Thus, the losses of biodiversity and the difficulties of portraying the real risks involved can be seen to offer a profound commentary on the inherent weaknesses of industrial paradigms and of several Western cultural beliefs. In terms of successfully navigating the larger transition to a post-fossil-fuel era, these losses point to a key dilemma of industrial societies—that they are undermining, weakening, and/or destroying the multitude of renewable resource systems (natural and culturally

constructed) on which they will become more dependent in the future. The unsustainability of current patterns of agriculture, forestry and fisheries illustrates this. Particularly striking are monocultural practices, clear cutting in forestry, and the use of drift nets.

The growth of economic inequality

The expansion of industrial societies and the economic inequalities that have grown with them have been facilitated by two important myths. One is a belief in the beneficence of 'the market' and its 'hidden hand'. The other is in the beneficence, yet neutrality of technologies.[15] Couched in larger visions of social progress achieved through reason and science, these two myths, combined with the development of fossil fuels, made possible the development of technological systems and institutions which have exploited both natural and social environments. They made socially and politically acceptable the uncounted 'externalities' of economics and the 'side-effects', or, at worst, 'the price of progress', of technologies. The result has been to create increasingly unequal economic systems—with the rich becoming increasingly powerful, whether at local, national or international level.

In terms of agriculture, inequalities historically grew out of the dispossession of native lands and the subjugation of peasants. Today, the green revolution, plus an ever-increasing emphasis on cash crops for export have marginalized peasants and subsistence agriculture. Past and present inequalities have led to native uprisings, peasant revolts, class conflict and other forms of resistance.[16] Also, the historic separation and inequalities that have developed between urban and rural peoples have been compounded by the increasing power of corporate and commodity groups to make national and international agricultural policy. All these trends have been rationalized in terms of 'progress' and the use of science and technology to expand productivity and markets.

These social myths have now been taken on ideological dimensions as defences of the status quo. Sadly, they have also weakened efforts at reform. While there has been some demystification of conventional economics and its theories of 'trickle down', there has been much less demystification of the non-neutrality of technologies and technological systems.[17] Indeed, this may be one of the key cultural mental blocks in the way of reform. The continuing power of these myths can be seen in the debates over biotechnology.

Clearly, the four areas of global constraints and/or threats present formidable challenges to the building of regenerative food and fibre systems. The label 'regenerative food and fibre systems' has been used in preference to the more commonly accepted term 'sustainable agriculture' for several important reasons. First, it points more directly to the need to regenerate both natural and social systems over time.[18] This requires not only multigenerational analysis, but the inclusion of issues of social justice, intergenerational equity, and interspecies equity. It also suggests both the need for systems thinking and the need to look at complete food and fibre systems, not just production agriculture. Finally, the label is less easily co-opted than 'sustainable agriculture' or 'sustainable development'.[19]

To build these new systems, several things are needed. One key priority is to maintain and enhance those remaining indigenous and traditional food and fibre systems that have demonstrated their regenerative capacities over the centuries. Seeking to do this also encourages us to learn from these systems and cultures as we seek to build new ones.[20] However, for these things to happen, there will have to be

a restructuring and decolonization of current world agricultural, forestry and fishery systems.[21] In addition, all this needs to take place within the larger transition to a post-fossil-fuel era and its required changes, of which there are many.

To begin, there is the much discussed need for fundamental changes in worldview. A crucial part of this is a shift from the historic utopian vision of rational industrial societies built any- and everywhere to a new *eu*topian vision of different good communities rooted in a variety of good places.[22] This is something that ultimately will require us to move from universal/generalization thinking, models and concepts to some type of contextual analysis that is grounded in specific periods, places and processes.[23] From there, shifts will be required in the evaluative criteria we employ—whether for society at large or for particular sectors like agriculture. Basically this involves a shift from economic growth and productivity criteria to health criteria—where the health of interacting natural, social and technological systems at different levels is evaluated over multiple generations.[24] We will also have to re-embed both economics and technologies into their surrounding natural systems and social institutions.[25] And for this to happen, the myth of the neutrality of technologies will have to be demystified both conceptually and politically. Let us turn to how this applies to the transition to regenerative food and fibre systems.

Transition to regenerative systems

Restructuring and decolonizing industrial agriculture, forestry and fisheries

For many, part of the vision of a 'global village' is a 'global supermarket' run by multinational corporations and facilitated by free trade in both inputs (germplasm, equipment, fertilizers, pesticides etc) and outputs (commodities and processed foods). Processing which adds value will continue to be done in the industrial countries or by subsidiaries of the multinationals. At the same time, Western diets and nutritional approaches—spread through food multinationals and global advertising—will gradually come to predominate, perhaps with a few local specialities admixed for 'spice'.[26] While this global supermarket can be expected to offer a wide variety of standardized products to those who can afford them, the energy inefficiencies will be very high and the social and environmental costs great. Thus, there will be continued talk of the need for better international systems to provide 'food security' for the poor countries.

To restructure and decolonize these emerging multinational regimes, a number of things will be needed. One involves efforts to 'internalize' the social and environmental costs of industrial agriculture.[27] Another involves rethinking the nature of trade, restructuring trade regimes, and broadening the types of negotiators involved in trade policy.[28] Other crucial changes include a redefinition of the 'limited liability' corporation and an abandonment of the legal fiction that corporations are 'persons' entitled to the same constitutional rights as individuals.[29] Many other measures to re-embed corporate and bureaucratic embodiments of the economic paradigm back into a larger democratic and social framework are also needed—ranging from land reforms to political and tax reforms.

Maintaining and enhancing indigenous and traditional food systems

As indicated above, these food systems are reservoirs of both cultural diversity and biodiversity. As such their maintenance ultimately depends on Western societies

developing a greater and deeper appreciation of their value. It also depends on finding ways to institutionalize systems approaches to research and policy making. Conceptual and bureaucratic fragmentation (a basic component of industrial 'divisions of labour') has meant that few have understood the full dimensions of diversity. It is no accident that a greater appreciation for biodiversity has emerged along with the growth of ecology.

As indicated above, anthropologists have tended to do the best research on indigenous food systems and their dependence on cultural diversity and biodiversity. Good work on traditional peasant agricultures is more scattered.[30] Sadly, crop germplasm collectors and researchers have traditionally been interested only in the seeds they collect. The accompanying 'passport' document listing all the 'vital characteristics' includes only information on the plant itself, plus some data on general climate and soil conditions. Thus, the great seedbanks of the world are 'libraries' that contain little or no information on the cultural, economic, cultivation, preparation, taste or other human dimensions of the food crops and the food that the seeds produce.[31]

Agricultural policy making at the national level has historically been flawed not only by a similar fragmentation, but by its isolation from (and resistance to) urban issues. Agricultural policy is typically dominated by large landowners, rural elites, powerful commodity groups, and, increasingly, the food industry. At the international level, trade negotiations (especially the GATT negotiations) are strengthening the corporate side of this coalition at the expense of the rural and farmer side.[32] What this means in terms of diversity is that now even national differences in industrial agriculture are threatened with homogenization. Thus, it would seem clear that the preservation of indigenous and traditional agriculture depends upon the simultaneous building of new regenerative food and fibre systems and the restructuring and decolonization of industrial agriculture.

Building regenerative food and fibre systems

Much of the rhetoric of sustainable agriculture calls for localizing food systems. Yet most proponents deal only with the role of farming in this. Regenerative food and fibre systems must include cities and need to be built at many levels—from the household level on up (recognizing again that a significant degree of restructuring and decolonization from the top down will have to accompany this). Also, these systems will need to be designed to create greater self-reliance at each level.[33] At each level different needs and opportunities can be seen.

The household offers great potential for families (however defined) to reduce their dependence on the larger formal economy. A wide variety of services and production for own use can be done in the household. The multiple linkages and loops between food, energy, water, composted wastes, gardens and self-reliance have been well illustrated in *The Integral Urban House*, which argues for reforming existing housing and ways of life to make them less resource- and job-dependent.[34]

There is also an increasing interest in reshaping neighbourhoods to make them more self-reliant.[35] Besides promoting community gardens, neighbourhood centres, and local grocers, the basic landscapes of cities need to be rethought in terms of the natural systems that interweave them. Rather different approaches may be required for smaller towns as compared to large urban centres.[36]

At the city level there is increasing interest in food policy councils which seek to understand and coordinate the various food system policies and activities of a city.[37]

Few people are aware of the high economic and employment value and potential of local and regional food and horticultural systems in the formal economy, much less in the informal.[38] Fewer still are aware of the larger food and energy flows and cycles of cities. A useful image of the needed shift towards systems thinking and new evaluative criteria is evoked by the title of the 'Healthy cities' programme of the World Health Organization. While currently focused on public-health-related matters, this image could easily be expanded to include the health (over time) of all the natural, social and technological systems of a city. As noted above, the shift from economic and production criteria to health criteria is one of the key elements in building more regenerative and sustainable systems.

Cities and metropolitan areas exist within regions. Calls to make cities and their regions more self-reliant have clustered around concepts of bioregionalism, landscape ecology and urban agriculture.[39] Another metaphor might be 'foodsheds' —at least for the food-related aspects of regions.

The variety of terms and concepts for the food systems found at these lower levels reflects the general conceptual vacuum that exists there. At higher levels, our conceptual language starts shifting back to more traditional concepts based in economics, law or politics. However, these are typically inadequate to capture the systemic dimensions. Broad-gauge critiques are needed to show these and to bring out real alternatives. One useful example is the critique of 'hard energy paths', made by Amory Lovins. By critiquing these centralized, capital- and energy-intensive, and highly complicated systems, he is able to show the alternatives.[40] What I have termed industrial agriculture might also be termed the 'hard agricultural path'. Analogous concepts in other sectors are needed to point to alternatives.

Economic sectors (especially energy and agriculture) are important parts of national and international policy. At both levels, 'sustainable agriculture' is primarily understood by most agricultural researchers and policy makers to involve reducing the environmental impacts of industrial agriculture.[41] Linkages to the larger search for 'sustainable development' are mentioned only rhetorically. And ironically, the industrial countries do not see their own need to pursue the rural (re)development they recommend to the Third World.

At the international and global levels, there have been extensive discussions of both sustainable development and global change. Neither has examined the crucial role of renewable resource systems at the regional level, where contiguous states are interwoven with complex land tenure and use patterns, climatic regimes, trade patterns, dietary preferences etc. These must be understood to pursue regenerative (or sustainable) strategies effectively.[42] Globally, the Gaia hypothesis has attracted a wide range of people seeking alternatives—in contrast to the more common image of the 'global village'. The Gaia hypothesis is holistic and ecologically based and implies major reforms, while the 'global village' image is linked to high-tech electronics and can be seen as the latest elaboration of industrial society.

In summary, whatever the different alternative images at each level, any actual movement towards regenerative systems will still have to be based on a shift to health criteria and on a fundamental respect for biodiversity and cultural diversity as the sources of life and social viability. We need new institutions and technological systems which embody and express this respect and which are not crippled by myths of technological neutrality. Since food and fibre systems are one, if not the major, interface between natural and social systems at all levels, the construction of regenerative food systems is one of the central components for making the transition to a post-fossil-fuel era.

Notes and references

1. J. W. Bennett and K. A. Dahlberg, 'Institutions, social organization, and cultural values', in B. L. Turner II (editor), *The Earth as Transformed by Human Action* (Cambridge, Cambridge University Press, 1990), pages 69–86.
2. Rather than seeking one 'objective' definition, 'regenerative food and fibre systems' are better understood in terms of process and context, wherein their capacity to co-adapt in specific natural and cultural environments enables them to provide human and other populations with their basic food and fibre needs over multiple generations.
3. A fifth major threat—that of the proliferation of nuclear weapons and other weapons of mass destruction—will not be addressed here. In many ways, however, the fundamental shifts in worldviews and priorities which are required for military conversion will greatly facilitate addressing the other major threats.
4. The value of garden produce (rural and urban) in the US is $18 billion—which is roughly equivalent to the value of the corn crop! (National Gardening Association, 'National gardening fact sheet', Burlington, VT, USA, 1989). The size of the informal sector and of urban agriculture in the Third World is even larger. For a discussion, see J. Smit and A. Ratta, 'Urban agriculture: a tool to reduce urban hunger and poverty', *Hunger Notes, 18*(2), Fall, 1992, pages 7–12.
5. The concept itself is now attracting increasing attention among a small handful of scholars and activists. Of course, a number of people have done extensive work on various components of food systems, but it is quite uneven and often fragmented.
6. J. Steinhart and C. Steinhart, 'Energy use in the United States food system', *Science, 184*, 1974, pages 307–316. Roughly one-third of the energy use occurs in production, one-third in processing and transportation, and one-third in local marketing and household refrigeration and cooking. These energy studies need to be updated and expanded to include the energy costs of handling the waste stream.
7. As all farmers know, it is not the average rainfall that counts, but how much rain falls where during which part of the growing season. The same applies to droughts and early or late frosts. See M. Glantz (editor), *Societal Responses to Climate Change: Forecasting by Analogy* (Boulder, CO, Westview Press, 1988).
8. Monocultures offer an example in agriculture. Their vulnerability to massive disease and/or pest outbreaks means that we could face the equivalent of a modern-day potato famine with any of our major grain crops.
9. Using various conversion ratios, Georg Borgstrom came up with the following 'biological ranking of nations': Argentina 6th rather than 23rd; Ethiopia 11th rather than 25th; and Japan 21st rather than 5th. See G. Borgstrom, *The Hungry Planet* (New York, Macmillan, 1965).
10. See World Resources Institute, *World Resources: 1992–93* (New York, Oxford University Press, 1992), Table 18.3 ('Livestock populations and grain consumed as feed, 1978–90'), pages 276–277. The application of industrial production techniques to livestock—where genetic engineering techniques are combined with 'confinement facilities'—raises a host of additional ethical, economic, environmental and health questions.
11. The latter is seen in the 'hamburger connection', where tropical rainforests in Central and South America have been cut down to provide grazing land for cattle destined for fast-food hamburgers. For a strong and detailed discussion from an animal rights perspective, see Jeremy Rifkin, *Beyond Beef: The Rise and Fall of the Cattle Culture* (New York, Dutton, 1992).
12. Ecologists define complexity in terms of the number of distinct species in an ecosystem. In these terms industrial societies are 'complicated' (like a clock which has many interlocking parts, but only a few 'species'—gears, springs, bearings etc), but are not complex.
13. Rather than using only utilitarian and economic arguments about the value of biodiversity as a resource, its defenders also need to emphasize that it is the ultimate *source* of living systems and their regeneration and thus worthy of a more fundamental kind of protection than '*re*-sources'.
14. S. B. Brush, 'The environment and native Andean agriculture', *American Indigena, 40*, 1981, pages 161–172. In this case, cultural simplification through 'development' clearly threatens the loss of crop biodiversity.
15. A common example of the myth of technological neutrality is expressed in the bumper sticker, 'People kill people, guns don't kill people'. This in spite of the fact that the design principle of guns is to deliver a high-speed projectile with deadly accuracy. Other sources of non-neutrality include the scale of technologies and the physical and social environment in which they developed.
16. In areas where inequalities are high—like Central America—peasants and rural people have rebelled. This shows that social justice is a major part of making agriculture sustainable.
17. K. A. Dahlberg, 'The value content of agricultural technologies', *Agricultural Ethics, 2*(2) 1990, pages 87–96. The various assessment procedures—environmental, social and technological—all help to demonstrate such non-neutrality, which is one reason they are so resisted by promoters and developers.

18. For example, the regeneration of farm families involves everything from farm and rural economics to good local education and healthcare, to general rural viability, and to inheritance laws.
19. For a discussion, see K. A. Dahlberg, 'Sustainable agriculture—fad or harbinger?', *BioScience*, *41*(5), May 1991, pages 337–340.
20. M. A. Altieri, *Agroecology: The Scientific Basis of Alternative Agriculture* (Boulder, CO, Westview, 1987).
21. For a discussion of the concept of 'decolonization', see J. Robertson, *The Sane Alternative* (St Paul, MN, River Basin Press, 1979).
22. M. Kaufman, 'The new homesteading movement: from utopia to eutopia', in S. TeSelle (editor), *The Family, Communes, and Utopian Societies* (New York, Harper Torchbooks, 1972), pages 63–82. For new urban approaches, see H. Girardet (editor), *The Gaia Atlas of Cities: New Directions for Sustainable Urban Living* (New York, Gaia Books, 1992); and R. Stren *et al*, *Sustainable Cities: Urbanization and the Environment in International Perspective* (Boulder, CO, Westview Press, 1992).
23. Contextual analysis draws on ecological hierarchy theory, but goes beyond it to include social and technological systems. See K. A. Dahlberg, 'Regenerative food systems: broadening the scope and agenda of sustainability', in P. Allen (editor), *Food for the Future* (New York, John Wiley, 1993), pages 75–102.
24. This also nests such evaluations in a larger evolutionary/adaptive framework.
25. For a classic statement on this, see K. Polanyi, *The Great Transformation* (Boston, MA, Beacon Press, 1957).
26. For example, Japan now has the second largest number of McDonalds outlets in the world. See also, J. D. Gussow, *Chicken Little, Tomato Sauce and Agriculture: Who Will Produce Tomorrow's Food?* (New York, Bootstrap Press, 1991).
27. For a discussion of the different aspects involved, see K. A. Dahlberg (editor), *New Directions for Agriculture and Agricultural Research* (Totowa, NJ, Rowman and Allenheld, 1986); M. J. Dover and L. M. Talbot, *To Feed the Earth* (Washington, DC, World Resources Institute, 1987); and Allen (editor), *op cit*, reference 23.
28. Doctrines of 'free' trade have historically been promoted by the dominant trading countries. Today, these doctrines have also become an ideological defence for the operations of the MNCs. 'Fair' trade addresses some of the labour and environmental 'externalities' of trade. 'Sustainable' trade involves the more fundamental rethinking called for here.
29. These earlier social innovations greatly facilitated industrialism. The power (market, social and environmental) of MNCs and oligopolies and the inability of anti-trust laws to weaken their market power require a rethinking. A prime example in agriculture is the power of the five US grain trading companies that control some 80% of the market.
30. See M. L. Oldfield and J. B. Alcorn (editors), *Biodiversity: Culture, Conservation and Ecodevelopment* (Boulder, CO, Westview, 1991).
31. Equally, research in small and/or exotic animals and livestock has been neglected. See N. Vietmeier, *Microlivestock: Little Known Animals with a Promising Economic Future*, Board on Science and Technology for International Development (Washington, DC, National Academy Press, 1991). I remember the frustrations expressed by an Israeli researcher who convincingly argued the virtues of promoting camel milk over cow's milk in Africa, but who could get no funding.
32. For example, French farmers and rural France will suffer greatly if current GATT proposals are passed. Equally, the Japanese are expected to sacrifice a major cultural symbol—rice and its local (but higher cost) production—on the altar of 'free' trade. Clearly, even under rethought policies of 'sustainable' trade, there would be questions of how to distinguish between legitimate and non-legitimate forms of protectionism.
33. Approaches to self-reliance do not seek the autarchy of self-sufficiency; rather, a type of bottom-up economic federalism based on each lower system providing for itself as much as possible before joining with higher-level systems to provide for unmet needs. Besides the increased energy efficiencies they offer, such approaches can also maintain and/or increase diversity. Clearly, changes in this direction will take time and a transition strategy will be needed.
34. H. Olkowski *et al*, *The Integral Urban House* (San Francisco, CA, Sierra Club Books, 1979). Like many other now out-of-print books from the 1970s, this valuable work should be updated and re-issued.
35. For an imaginative high-tech vision of this for a New York City neighbourhood, see Richard L. Meier, 'Sustainable cities will feed themselves: design of a working model of an urban ecosystem for New York', paper presented at the World Futures Society meeting, 29 June 1993, Washington, DC.
36. One visually imaginative example for a smaller city is contained in R. Britz (editor), *The Edible City Resource Manual* (Los Altos, CA, William Kaufman, 1981), which shows a series of stages by which city land-use patterns in Eugene, Oregon could be rearranged to promote neighbourhood food systems.

37. *Municipal Food Policies* (Washington, DC, US Conference of Mayors, October 1985). In my own research, I have been doing a follow-up study of the food policy councils in the five cities examined in the US Conference of Mayors report.
38. For example, in the Delaware Valley in Pennsylvania, between 20% and 25% of the labour force are employed in food, horticulture and agriculture, and food ranks third in venture-capital expenditures. R. Koppel, *Agenda for Growth* (Philadelphia, PA, Food and Agriculture Task Force, 1988).
39. On the latter, see C. R. Bryant and T. R. R. Johnston, *Agriculture in the City's Countryside* (Toronto, University of Toronto Press, 1992); and Smit and Ratta, *op cit*, reference 4.
40. These are 'soft energy paths', which are decentralized, energy-diffuse, labour-intensive, and locally manageable and reparable. See A. B. Lovins, *Soft Energy Paths* (San Francisco, CA, Friends of the Earth, 1977).
41. See National Research Council, *Alternative Agriculture* (Washington, DC, National Academy Press, 1989); and Food and Agriculture Organization (FAO), *Sustainable Agricultural Production: Implications for International Agricultural Research* (Rome, FAO, 1988).
42. K. A. Dahlberg, 'Renewable resource systems and regimes: key missing links in global change studies', *Global Environmental Change*, *2*(2), June 1992, pages 128–152.