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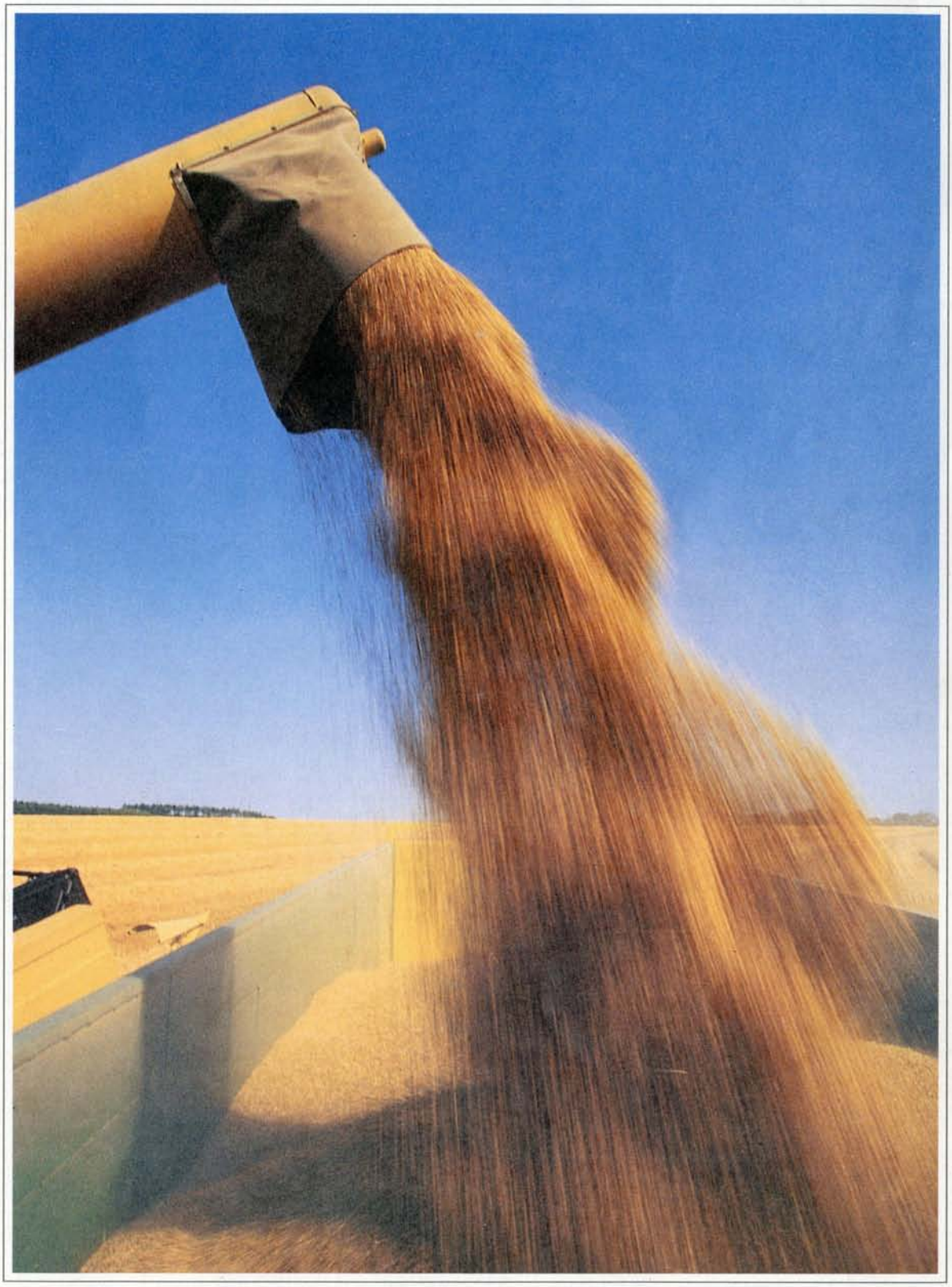

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- Environmental Risks of Genetically Engineered Crops
- Creating Food "Scarcity"
- Agriculture & Climate Change
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Food Insecurity

Who Gets to Eat?

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Free trade is increasingly considered to be the best way of ending world hunger. The removal of trade barriers, it is argued, will allow countries to "reap the benefits of comparative advantage" and enable domestic consumption to be met more cheaply by less costly imported supplies. But while Southern countries have been obliged under the Uruguay Round of GATT to remove subsidies to their farmers, subsidies to Northern producers remain intact. Far from relieving hunger, liberalization is increasing food insecurity by throwing Southern producers into unequal competition with the heavily-subsidized, capital-intensive agricultural systems of the North. Millions of livelihoods will be lost as a result. An alternative trade agenda is urgently required — one that promotes greater food self-sufficiency in the South, with a focus on smallholder producers, and that accepts the need to restrict imports in the interests of tackling the underlying causes of hunger.

Off-farm agricultural research plays a central role in shaping the current and future direction of agriculture. Who controls that research and who sets its agenda is of critical importance for food security. Of particular concern is the influence exerted by the Consultative Group on International Agricultural Research (CGIAR). Under its direction, research has been geared towards intensive, industrialized methods of production — at great cost to genetic diversity, the environment and poorer farmers in the South. Non-governmental organizations are pressing CGIAR to implement wide-ranging changes so as to restructure its research agenda and decision-making processes.

Many interest groups claim that an increasing world population cannot be fed unless genetically engineered crops are grown. Such crops, so the theory goes, will produce higher yields than conventional farming methods and have fewer adverse environmental impacts because the frequency, range and toxicity of weed-killer and pesticide applications will be reduced. Ecological risk assessments are said to indicate that several products can be grown safely on a wide scale. In fact, growing genetically engineered plants is likely to increase the use of herbicides and pesticides and to accelerate the evolution of "superweeds" and "superbugs". Crucially, major environmental risks are unpredictable effects and the unintended transfer of transgenes to plant relatives. Risk assessments are limited and have primarily been based on an outdated understanding of gene behaviour.

Cover Photo: Harvesting barley near Hungerford, Berkshire, UK (Nigel Dickinson/Still Pictures).
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Cynicism, Food and Power

The Editors

Unicef

"Within a decade, no man, woman or child will go to bed hungry", vowed Dr. Henry Kissinger as US Secretary of State in 1974 in his keynote speech to the World Food Conference. Yet more than two decades later, at the time of the World Food Summit in November 1996, 800 million men, women and children (several countries more than the combined populations of the United States, the United Kingdom, France, Germany, Italy, Spain, Greece, The Netherlands, Belgium and the Scandinavian countries) were still going to bed malnourished, hungry or starving. This time, the gathering did not reiterate Kissinger's promise, but instead offered the starving an "Action Plan" to reduce the numbers of hungry people by half within two decades — in effect, officially sanctioning the continued malnourishment of some 400 million people for the next 20 years and beyond.

Such cynicism — masquerading as "realism" — was roundly condemned by Fidel Castro, President of the Communist Party of Cuba. "Hunger", he told the Summit, "is the offspring of injustice and the unequal distribution of the wealth in this world." Indeed, the history of hunger has *always* been a history of unjust social and economic systems which have marginalized the poor and deprived them of the means to eat.

Rather than address these systems, the powerful and well-fed invariably turn to a litany of handy explanations for the hunger of others — be it economic mismanagement, technological backwardness, feckless bedroom habits or genetic inferiority. The delegates at the World Food Summit (a handful apart) were no exception.

The result is an Action Plan that does nothing to tackle the root causes of hunger but a great deal to nurture them. It presents rhetorical concern for landlessness, but no measures to address the need for agrarian reform. It contains plenty of fine words to condemn poverty, but no measures to curb the power of the transnational corporations whose control over international trade in food lies behind much of the starvation in the world today. It outlines commitments to increase rural employment, but no measures to address the declining bargaining power of the rural poor in an age of globalization and "devil-take-the hindmost" economics. Far from undermining the power structures that generate hunger and malnutrition, the Action Plan insists on trade liberalization and other agricultural policies that will further entrench the very forces depriving the poor of food.

As NGOs and peoples' representatives gathered at the Summit made clear in their final statement, ensuring food security demands an approach to agricultural policy that is, in almost every respect, the *reverse* of that adopted by the Summit's delegates. Instead of requiring countries to liberalize their agricultural markets, it demands respect for the rights of nations to "achieve the level of food sufficiency and nutritional quality [they] consider appropriate without suffering retaliation of any kind". Instead of pursuing policies that encourage the spread of corporate agriculture, it demands the "reorientation" of policies "in favour of family farmers". Instead of encouraging industrialized agriculture, it demands policies that favour "organic production . . . with the goal of reducing or eliminating the use of pesticides and other agro-chemicals." Instead of policies that concentrate control over land and decision-making in the hands of large landowners, corporations and distant bureaucrats, it demands "agrarian reform in favour of rural poor people who will work the land." And instead of locking farmers into a global economy over which they have little control, it demands that "resources . . . be shifted in favour of local and regional food producers and food systems."

As the peasant movement Via Campesina pointed out, "Food sovereignty can only be achieved through solidarity and the political will to implement alternatives." Acting together to create such political will offers the best hope of ensuring that the 400 million people written off by the World Food Summit do not starve.

Free Trade and Farm Fallacies

From the Uruguay Round to the World Food Summit

Kevin Watkins

Free trade is increasingly held to offer the best route to end world hunger. The removal of trade barriers, it is argued, will allow countries to "reap the benefits of comparative advantage" and enable domestic consumption to be met more cheaply by less-costly imported supplies. While Southern countries have been obliged under the Uruguay Round of GATT to remove subsidies to their farmers, subsidies to Northern producers remain intact. Far from relieving hunger, the liberalization of agriculture is increasing food insecurity by throwing Southern producers into unequal competition with the heavily-subsidized, capital-intensive agricultural systems of the North. Millions of peasant livelihoods are likely to be lost. An alternative trade agenda is urgently required — one that promotes greater food self-sufficiency in the South with a focus on smallholder producers, and that accepts the need to restrict imports in the interests of tackling the underlying causes of hunger.

Free traders have seldom had it so good. Not since British Prime Minister Lord Palmerston dispatched gunships to open the Chinese market for British opium in the 1840s has theory inspired such certainty, nor trade barriers such opprobrium. Free trade is the religion of our age. As US economist J K Galbraith remarked, "no one can be without sin who does not at least daily reaffirm his belief in the profound beneficence of free market forces."[1]

Nowhere is free trade theory embraced with more enthusiasm than in matters of agricultural policy. Today, no meeting of agricultural ministers, whether from the developed or developing world, is complete without a celebration of market principles and the agricultural agreement resulting from the Uruguay Round of GATT. That agreement, concluded in 1994, is presented as a major step towards the creation of a world free of trade barriers which will benefit all countries.

The most recent celebration of the drive towards liberalization in agriculture was held at the World Food Summit in Rome in November 1996, under the auspices of the UN Food and Agriculture Organization (FAO). In many respects, the event offered the familiar UN cocktail of vacuous communiqués contrived in expensive surroundings under the gaze of the world's media. One phrase, however, in the joint declaration issued by participating governments summarizes the new policy environment:

> "We will strive to ensure that food, agricultural trade and overall trade policies are conducive to food security for all through a fair and market-oriented world trade system."

There are two problems with this statement. First, "market-oriented" systems of production and distribution do not have a good track record in feeding people, nor in tackling the underlying structures of poverty which consign over one quarter of the world's population to hunger. Second, while such systems may be widely endorsed by Northern governments in theory, and equally widely recommended for Southern governments, free market principles are, in practice, conspicuous by their absence in the design of agricultural policies.

Double standards are hardly a novel feature of world trade relations. But in the specific case of agriculture, the approach endorsed at the World Food Summit will, from the perspective

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of food security, achieve the worst of all worlds. Northern governments will continue to subsidize their industrialized farming systems, ensuring that they generate vast surpluses for export. The Uruguay Round agreement will do little or nothing to change this picture since it was written by the United States and European Union to accommodate their "right" to subsidize production and to dump surpluses on world markets at artificially depressed prices. However, the Uruguay Round does require developing countries to liberalize their food systems, notably by reducing restrictions on imports. The upshot is that smallholder producers in the South will be locked into ruinous and highly-unequal competition with the industrialized farming systems of the North.

This is a recipe for social, economic and environmental dislocation. It also raises the spectre of an accelerated loss of food self-reliance, as countries become more dependent upon imports and as local production of staple foods declines in the face of competition from these imports.

This is precisely the outcome which the US and the EU intend — and which FAO is actively promoting. In the case of agriculture, free trade rhetoric has served as a convenient smokescreen for the pursuit of vested interests. An alternative trade agenda which reflects market realities and human needs is urgently needed. That agenda should include the promotion of greater food self-reliance in the developing world, with a focus on smallholder producers, and it should include a trade regime which accepts the need to restrict imports in the interests of tackling the underlying causes of hunger.

Free Market Myths

Central to FAO's view that free markets offer the best route to ending world hunger is the belief that "trade will allow domestic food consumption to be met more cheaply by less costly imported supplies".[2] The advantages of free trade, according to FAO, are particularly marked for countries in which the overall availability of domestically-produced food staples is in decline, since increased imports will keep food prices low.[3] To cover their food deficits, FAO recommends that Southern countries open up their markets to foreign food producers and import Northern surpluses. Furthermore, the removal of any domestic trade barriers will supposedly enable all countries "to reap the benefits of comparative advantage"[4] and improve national economic performance by discouraging unproductive activities. FAO does concede that liberalization will create adjustment costs for producers, but insists that such costs will be outweighed in the longer-term by opportunities for export and the wider benefits of modernization.

In the real world, however, agricultural production and trade is determined not so much by comparative advantage as by comparative access to subsidies — an area in which food producers in the industrialized world enoy an unrivalled advantage over those in developing countries.

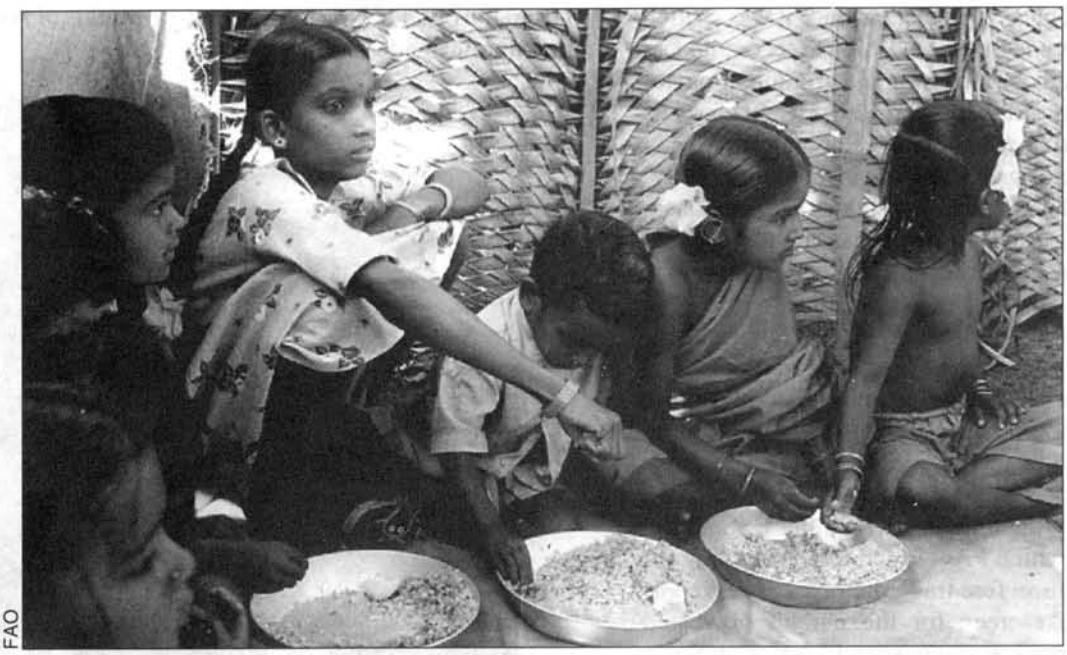
Far from creating "market conditions" in which prices reflect the real costs of production, the removal of a country's trade barriers actually distorts markets by sending false price signals through the trading system and throwing smallholder food systems in the South into unequal competition with the North's heavily-subsidized, large-scale, capital-intensive agricultural systems. To borrow the favoured analogy of free traders, the level playing field in world agriculture runs all the way downhill from Europe and North America to the fields of Asia, Latin America and Africa.

Competition? What Competition?

Take the case of cereals. These are the largest category of internationally traded foodstuffs, generating around $20 billion annually. Between them, the United States and the European Union account for over half of all exports of wheat and wheat flour, while the US alone accounts for over three-quarters of maize exports. Because producers in the US and EU dominate world cereal markets, the prices at which they export effectively dictate world cereal prices — and hence the prices against which producers in importing countries have to compete. The subsidies paid to US and EU producers therefore play a key role in determining the price at which cereals are traded, not just in the North but worldwide.

These subsidies are huge — the US and the EU spent over $15.7 billion in 1995 subsidizing wheat and maize production alone — and far outstrip the financial support available to farmers in the South.[5] As a result, trade in cereals is massively distorted in favour of Northern producers, which can dump their surpluses on the South at heavily subsidized prices. The average subsidy, for

Creating Food Deficits and Dependency



FAO

Since the Second World War, the dominant theme of US and EU agriculture has been a failure to control production and a relentless drive to expand export outlets for the resulting surpluses.

Developing countries, which now account for over half of world cereal imports, have been developed as markets through a combination of food aid and commercial export dumping. Stated differently, food deficits in the South have been assiduously cultivated by policy makers in the North.

Indeed, the deficits are, in large measure, a consequence of the disincentive effects for local agriculture created by "cheap" (that is, heavily-subsidized) imports. During the 1960s, for example, a central objective of the US PL480 food aid programme was to transfer consumer demand for food in the South into demand for US wheat. By the mid-1960s, this programme accounted for over one-third of US cereal exports, laying the foundation for multi-million dollar markets in countries such as the Philippines and Colombia, in part by destroying local production capacity.

The relationship between subsidized food dumping and the creation of food dependence is particularly apparent in sub-Saharan Africa, which three decades ago was self-sufficient in basic food staples. Since the 1970s, however, wheat imports have increased by over 200 per cent, with net imports rising from three million to nine million tons. Related to the increase in imports, per capita production has declined from 135 kilogrammes to 112 kilogrammes.

Food dumping by the industrialized countries played a key role in this surge in import demand. In the latter half of the 1980s, the US and the EU were selling wheat at prices as low as $60 per ton in West Africa, equivalent (in the case of the EU) to around one-quarter of the intervention price paid to farmers. For local producers of staple food crops, unable to compete with imports, it was a disaster. Local markets collapsed, household incomes fell, and investment in agriculture declined, leading to a widening gap between local production and demand to be filled through imports.

It is a depressingly similar story in Latin America and the Caribbean, where smallholder producers have faced intense competition, first from food aid under the PL480 programme, and then from subsidized commercial exports. For the region as a whole, per capita cereal production was lower in 1990 than in 1960.

In the Andean countries of Latin America, highland producers of potatoes have been displaced from urban markets by heavily subsidized cereals imports.

In Central America, production of basic staples such as beans, maize, roots and tubers has stagnated, while imports of rice and wheat are flooding markets on highly subsidized terms.

Figures from the FAO show a decline in per capita food production of 40 per cent from 1980 to 1991. Over roughly the same period (1983-1993) the per capita availability of calories declined from 2,425 to 1,716, pointing to the close association between local staple food production and food security.

example, to a US farmer producing wheat for export is around 25 times the total average per capita income in the 42 countries classified by the World Bank as "low income", and more than three times the average per capita income of the middle-income countries of South-East Asia and Latin America. Even these figures, however, understate the level of distortion in international food trade, since the producers of staple foods who have to compete in local markets against US exports usually have incomes far below the national average. On the Philippine island of Mindanao, for instance, over half a million corn farmers, who earn less than $100 a year, "compete" against corn imported from the US which has been produced with a subsidy amounting to one hundred times their income (even without taking into account subsidies for transport and marketing infrastructure).

To describe such competition as "free trade" requires a leap of imagination of which only the most creative economists are capable. Consider the case of the Philippines. In 1991, the country imported 1.2 million tons of

wheat from the United States, almost all of it under the Export Enhancement Programme (EEP) created by the US Department of Agriculture to counter "unfair competition" from the European Union — even though the Philippines is a virtual US monopoly. On average, the Philippines paid around $96 per ton of imported US wheat. Direct payments to US farmers for the same ton of wheat amounted to around $77 per ton, while exporters were provided with EEP subsidies of $40 per ton. Expressed differently, for every $1 of wheat imports purchased by the Philippines, the United States provided subsidies equivalent to $1.4. It is hardly surprising, therefore, that per capita production of rice and maize in the Philippines has stagnated; or that structural deficits in rice — amounting to over 800,000 tons over the past five years — now appear to be a fact of life.

One Rule for the North . . .

Advocates of trade liberalization acknowledge the market distortions caused by subsidies, but argue that these distortions will become a thing of the past once agreements reached under the latest revision of the General Agreement on Tariffs and Trade (GATT), which came into effect in 1995, are fully implemented.[6] Under new GATT rules, governments in the industrialized world are required to reduce their "trade distorting" subsidies by 20 per cent, and to lower export subsidies by 36 per cent in value terms and 21 per cent in volume terms. Not surprisingly, a widespread perception has developed that producers worldwide are all now competing on a level playing field.

In fact, the GATT agreement was an act of fraud. Far from dismantling the structure of subsidies in industrial countries, the agreement has left them largely intact, thanks to a side agreement negotiated bilaterally between the EU and the US known as the "Green Box". This agreement determined that direct payments to farmers — "set-aside" payments, for example, where farmers are paid to withdraw land from production — should be exempt from the subsidy cuts agreed under the main GATT agreement on the grounds that these payments do not promote agricultural production and are not, therefore, "trade distorting" measures.

Direct payments account for a growing proportion of subsidies provided under the EU's Common Agricultural Policy (CAP) and, according to the European

Environmental Dumping

If the Uruguay Round of GATT spectacularly failed to address the economic distortions in world agriculture, it comprehensively ignored the less visible, but equally important, environmental dimensions.

Under existing rules of the World Trade Organization (WTO), the body set up under the Uruguay Round to replace GATT, exporters are not allowed to market products at prices which do not reflect production costs. Anti-dumping provisions are enshrined in the WTO to prevent this practice.

There are no provisions, however, to prevent market distortions through "environmental dumping", which can be said to occur when export prices do not reflect the value of resources depleted in the production process.

In industrialized countries, the environmental costs of capital intensive farming are enormous. According to the European Commission, 25 million hectares of farmland in Europe are threatened by soil erosion — an area eight times the size of The Netherlands. In the US, over 400,000 hectares of land are being lost each year as a result of soil erosion, while water tables are falling by between six inches and four feet a year beneath one quarter of irrigated land area. The scarcity value of these resources is not reflected in export prices. Neither is the cost of reducing to safe levels the residues of fungicides, herbicides and insecticides which are washed into groundwater supplies and coastal waters.

Mark Edwards/Still Pictures

Spraying pesticide in Italy

Quantifying the economic costs of environmental damage or depletion is inherently difficult. But detailed research by the US-based Institute for Agriculture and Trade Policy (IATP) into the costs of production for spring wheat in the US graphically illustrates the problem. Using as a proxy for environmental cost the loss of productive capacity associated with soil erosion and soil compaction, the costs of wetland loss and the costs of water pollution, IATP estimated the environmental cost of a ton of spring wheat to be around $24 in 1990 — around one-fifth of the export price for that year. These narrowly-defined economic costs could be integrated into the WTO's anti-dumping provisions. The intrinsic value to communities of the environmental resources and wildlife destroyed by intensive agriculture, however, cannot be captured by economic accounting.

Markets, Prices and Malthus

International food summits have a habit of coinciding with periods of crisis in international agricultural markets. In the two years before the first FAO World Food Conference, held in 1974, prices of traded wheat, corn and rice doubled, prompting panic among policymakers. The US imposed an embargo on soyabean exports, and the EEC imposed levies to restrict exports of grain. Under the prompting of the Club of Rome, a group of academics and corporate leaders concerned about environmental issues, the stock of the Reverend Thomas Malthus, the eighteenth century clergyman who theorized the relationship between the growth in food supplies and growth in the number of people, surged almost as rapidly as world prices. Explanations which ascribed rising cereal prices to an absolute shortage of supplies due to population growth were widely accepted. Widespread starvation was predicted in developing countries, with the crisis in the Sahel region cited as a sign of things to come.

Moved by such dire projections, policymakers pledged action to head off the crisis. Agricultural trade was to play a central role in the solution. US Agricultural Secretary Earl Butz called on US farmers to plant "hedgerow to hedgerow" — and they did. Policy measures to increase output, both in the US and in Europe, focused upon price support, subsidies for bringing new land into cultivation, and support for increasingly capital-intensive farming.

While the rhetoric stressed the importance of the war against hunger, the projected imbalance between food supply and demand offered expansive new market opportunities. Powerful commercial interests, ranging from chemical suppliers to large farmers and corporate grain traders, saw in global markets potentially lucrative profits. For policymakers, export markets appeared to offer a resolution to the most protracted and intractable problem in industrial country farm policy: the tendency of supply to outstrip demand and generate costly surpluses.

Protracted Depression

Instead of opening the window to a golden age of agricultural prosperity, however, the productivity and output gains unleashed after the 1974 World Food Conference culminated in the deepest and most protracted depression in world markets since the 1930s. As supplies increased, markets went into reverse gear, generating huge surplus stocks. By the mid-1980s, policymakers were less concerned with problems of shortage than with the challenge of surplus disposal. Cereal stocks, held mainly in Europe and the US, were equivalent to two-and-a-half times annual trade volumes.

As world prices fell in the face of chronic oversupply, farm budgets spiralled out of control, with US agricultural spending rising between 1979 and 1980 by a factor of five to $25 billion. The EU's Common Agricultural Policy (CAP) teetered on the brink of financial collapse; in 1987, over one-third of its subsidies were used to dispose of and dump surpluses. An editorial in *The Economist* lamented the "Alice in Wonderland" logic which led governments to pay three times world market prices for cereals, which then required further subsidies to transfer them on to world markets.

Ever more imaginative ways to dispose of surpluses were sought and found. European cereals surpluses were used to fuel power stations, and the relative merits of dumping wheat in the North Sea as opposed to subsidizing its export to Russia keenly debated — the North Sea option was rejected only on cost grounds.

Policy makers in the US and the EU responded to the market crisis of the 1980s in time-honoured fashion, attempting to subsidize their way into an expanded share of contracting markets. In so doing, they deepened the price depression. For developing countries caught in the cross-fire of the EU-US subsidy barrage, the effects were disastrous. Falling prices and losses of market shares translated into foreign exchange losses, which in turn depressed farm incomes and compounded wider debt problems. In Thailand, the world's largest rice exporter, US rice dumping contributed to a steep rise in rural poverty, as falling world prices transmitted themselves to lower household incomes.

Plus Ça Change . . .

The experience of the early 1970s mirrors that of the past two years in several respects. Firstly, world prices are again on the increase — doubling in the two years between 1994 and 1996 — and international food stocks have fallen to their lowest levels since 1974. Secondly, Malthusian ideas are

Commission, are "production neutral". Even by the standards of the European Commission, however, this view defies credibility. Direct payment levels are determined by a formula which is based on land-holding and average yields, both of which are *production*-related. Indeed, by generating new investment, direct payments to farmers have had the effect of raising overall EU cereals output by some 30 million tons, according to the authoritative *Agra-Europe* journal. This is more than the average total of EU cereals exports for the second half of the 1980s.

Through the Green Box provisions, both the EU and the US have been able to maintain — and even increase — the level of subsidies going to their farmers. Direct payments now account for 23 per cent of agricultural subsidies in the industrialized countries — an increase of five per cent over 1986 when the Uruguay Round was initiated. Much of that increase is accounted for by the European Union, where the 1992 reforms of CAP shifted the focus of farm income support away from price interventions (in the form of guaranteed prices for given commodities) towards direct payments to producers. Exempting these direct payments from the Uruguay Round agreement reduced at a stroke the level of EU subsidy cuts required by over $3 billion in the case of wheat alone. In 1996, EU direct payments will account for over half the CAP budget, with producers having received $4 billion to compensate them for lower guaranteed prices, even though market prices have risen.

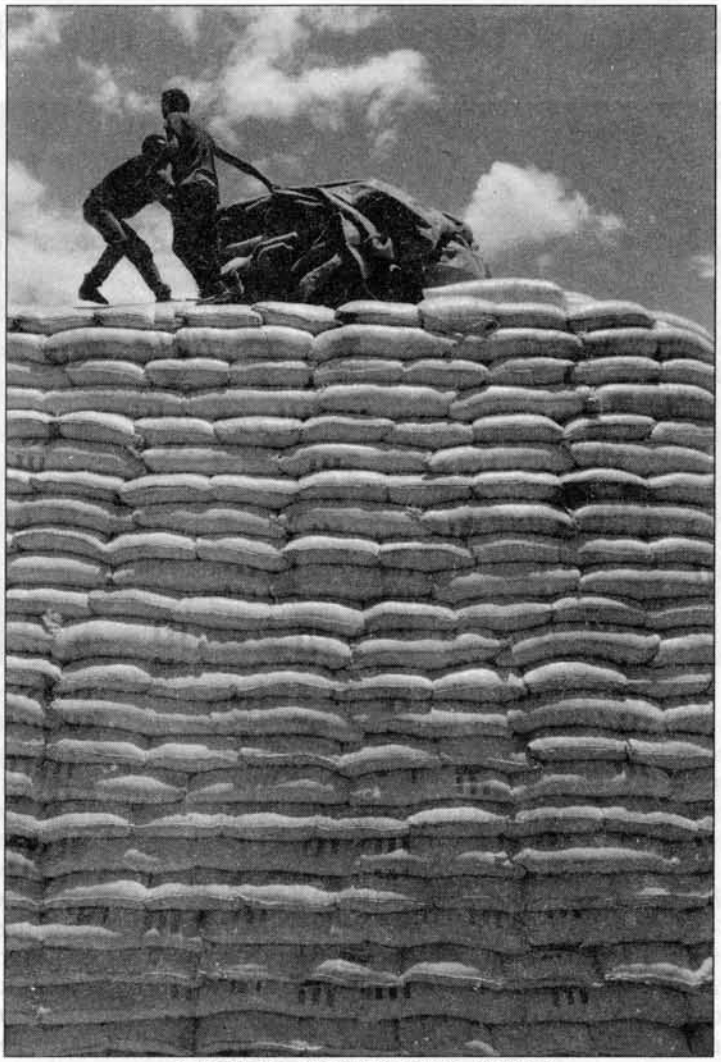
Similarly, in the US, the Green Box provisions have allowed production subsidies to continue. By the year

again resurgent. Returning to a familiar theme, neo-Malthusians have again seized on spiralling prices as proof of absolute shortages in food, this time because Chinese import demand is, in their view, outstripping the capacity of the major agricultural exporters to meet it.

Policymakers have responded, as they did two decades ago, by seeking to maximize production. Both in Europe and the US, powerful corporate lobbies have persuaded policymakers that lucrative markets are available for exploitation if supply controls are lifted. The upshot is that in the US an additional land area the size of The Netherlands has been brought under the plough. In Europe, already ineffective measures introduced to control supply have been similarly weakened. Under the set-aside scheme agreed in the 1992 CAP reforms, around 15 per cent of cereal land was to have been removed from cultivation — providing a welfare net for the landed classes. The set-aside provision has now been reduced to five per cent, with further reductions in store. Estimates for 1996 show that the area planted to cereals is only 0.2 per cent lower than in 1992. Moreover, subsequent rulings have introduced a number of loopholes into the original legislation. The most damaging of these is a provision allowing farmers to remove their least productive land from cultivation.

As in the early 1970s, the projections which provided the backdrop to the 1996 World Food Summit are deeply flawed. Recent hikes in international prices are a reflection not of absolute shortages in food (as neo-Malthusians argue) but of short-term fluctuations in the market for *internationally traded* food — a market which accounts for just 14 per cent of world food consumption. (The rest is grown, traded and consumed nationally.) In this instance, the fluctuations were caused by the coincidence of shortfalls in two successive US harvests and the entry of China into the market. These changes are rooted in the "thinness" of world markets, which are highly concentrated on both the supply and demand side. Because the US is the world's largest supplier of cereals, accounting for over one-third of wheat and two-thirds of maize exports, international prices are extremely sensitive to even modest production shortfalls in the American Mid-West, especially when new entrants — in this case, China — come into the market. In the view of most market analysts, including the OECD, the recent surge in world prices is a temporary event. Treating it as permanent will set the scene for another cycle of oversupply and low prices around the turn of the century.

It was the German philosopher, Hegel, who made the observation that history repeats itself. Marx added the quip that it did so first as tragedy and then as farce. If the history of Food Summits is the litmus test, Marx was right. The tragedy of 1974 was that the most pressing global food problems of the day were ignored and that policy responses to short-term market fluctuations exacerbated poverty and hunger by destroying livelihoods. We now stand on the brink of a repeat performance, which merits the billing of a grand farce.



A grain depot at Lilongwe, Malawi

Crispin Hughes/Panos Pictures

2000, subsidies of up to $16 billion will be permissible — double the 1995 level of national government support. In addition, a wide range of additional subsidies are exempt from reductions. These include the $1.5 billion of public finance spent in the US on research and development and the $2 billion allocated for crop insurance — both areas in which there are clear linkages with production.

Other elements in the small print of the Green Box provisions will diminish still further the efforts of the Uruguay Round towards establishing a level playing field. For example, export reduction commitments are less impressive than they appear, since the reference period against which these reductions are measured for the EU is 1991-1992 rather than the standard reference period of 1986-1990 — the level of subsidy in 1991-1992 was far higher than the 1986-1990 average. The upshot is that the agreement allows the EU to export over eight million tons more subsidized cereals exports than would otherwise have been the case.

There is another more serious problem, however: the commitment to reduce the volume of subsidized exports by 21 per cent means that 79 per cent of subsidized exports are still allowed under the new GATT rules — a considerable breach of free trade principles. Were South Korea to subsidize its colour television exports to the US on similar terms, the US judicial system would probably be unable to deal with the barrage of anti-dumping actions which would result, as powerful vested interests in industry mobilized to protect their markets.

Corn Livelihoods Threatened in the Philippines

Oxfam

Farmers Victor and Rosa Laranjo live on the island of Mindanao in South Cotabato province, the "corn basket" of the Philippines. Their two hectare farm on which they produce corn and a few vegetables is located in scattered plots on rugged hillside terrain. This is one of the most fertile areas in Mindanao; rainfall is plentiful, allowing for two harvests a year and unlike, other areas in the Philippines, the province is usually spared tropical depressions and monsoons. The island is a major producer of pineapples, bananas, flowers and green beans for export to Europe, the US and Japan; foreign companies such as Dole and Del Monte operate vast plantations on the island.

Yet half the island's households — some eight million people — live below the poverty line, lacking adequate shelter, nutrition and other basic necessities. The youngest two of the Laranjo's children, aged five and ten, are visibly underweight for their age. They are constantly ill with respiratory infections and diarrhoea, especially during the rainy season.

Apart from planting, weeding, cooking and tending her children, Rosa often walks to the municipal market 15 kilometres away to sell a few vegetables. Public transport is non-existent. The one road to town is a pot-holed dirt track, negotiable only by motorized tricycles. During the rainy season, it is often impassable for weeks at a time.

There is no health centre, supply of clean water or electricity. The local primary school is a ramshackle hut with gaping holes in the roof and few teaching materials. Many children in the area do not attend school. Of the Laranjos' three teenage children, two girls and one boy aged between 13 and 16 years old, only one completed primary school education. All three are now working, the daughters doing laundry service in the provincial capital of General Santos and the son on the family farm.

Most families on Mindanao grow white corn for their own consumption or to sell in local markets, and yellow corn to sell to the booming animal feedstuffs industry in the capital, Manila. As a source of livelihoods, corn is the second most important crop produced in the Philippines after rice, with yellow corn now generating the bulk of household cash income. "For us", says Rosa Laranjo, "the price we get for yellow corn is a matter of life and death. It shapes our lives, our health and our future".

That future is now under threat from the growing volume of imported subsidized corn. For the poorest households, even a small decline in income can translate into fewer meals, less nutritious food, diminished access to health care, further hardship in paying for primary education and pressure to transfer children from school into income-generation.

Another family who will be affected by increased corn imports are Dolores and Maximo Duran, both aged 30, who live in Bukidnon, a landlocked province in northern Mindanao and the second largest corn-producing area after South Cotabato. The Duran family farm just under two hectares of land, of which they own about two-thirds and pay rent on the remainder.

In 1995, the household planted one hectare of land to white corn. Most of the harvest was stored to meet family food needs. With two harvests a year, one in February and one in August, Dolores estimates that one hectare of land is sufficient to meet the family's food needs for around five months.

The other half of their land, with the exception of a small plot for growing vegetables, is used to produce yellow corn. Harvested at the same time as white corn, the entire crop is sold to traders after it has been shelled and dried on the roadside. The family derives around 80 per cent of its income from these sales, income which they use to purchase white corn and rice in local markets after their own supplies have been consumed.

With the application of fertilizers, yellow corn productivity levels are two to three times higher than those of white corn. The income generated by yellow corn enables the Duran family to buy twice as much white corn as they would have been able to grow. In addition, they do not have the capacity to store any more white corn on the farm.

In the two months before harvest, when food stocks and income from the previous harvest are low, the storekeeper of the local *sari-sari* (small grocery) store about seven kilometres from the farm extends credit to the Durans for household items and for yellow corn seeds and fertilizer. After the harvest, he collects the corn from the farm, subtracting an agreed amount in payment for the credit he has extended.

From this local trader, the yellow corn goes to a municipal trader in the town of Impasugong who owns trucks and storage facilities. From there, it travels in bulk to the port of Cagayan de Oro where it is sold to agents connected to animal feedstuff manufacturers in Manila. In 1995, the wholesale price in Manila averaged around Peso 7 per kilogramme — Dolores Duran would have received about half this amount when she sold her corn to the *sari-sari* owner. In the village of Calao Calao in the same province as the Durans' farm, the prices farmers received were about 20 per cent higher because road conditions are better — the village is located on a provincial highway — and thus transport costs lower.

As trade barriers fall and imports increase, smallholder farmers will be forced to sell their yellow corn at a lower price or to withdraw from the market. Overall household income is predicted to decline by 15 per cent by the year 2000 and 30 per cent to the year 2004.

. . . And Another for the South

But while the Uruguay Round of GATT leaves Northern subsidies and overproduction largely intact, some Southern governments will be required to implement far-reaching liberalization. All but the least developed countries will be required to reduce their tariffs on food imports by 24 per cent over ten years and to increase the minimum level of imports from one per cent to four per cent of consumption.[7]

The implications for rural poverty and food insecurity in the South are enormous. In the Philippines, for instance, the maize sector accounts for over half the cultivated area under food grain and around two million livelihoods. At the world price levels which prevailed during the second half of the 1980s, few maize farmers would be able to compete against foreign imports. According to one study, tariff rates of 100 per cent would be insufficient to protect the market share of Philippine maize producers against regional competition from Thailand. (This is partly because transport costs are high, especially to the main animal feedstuffs market in Manila, reflecting the dilapidated state of rural roads and infrastructure.)[8]

Exposing rural producers to global markets under these circumstances poses a powerful threat to rural livelihoods. In 1991, for example, producers in the Cagayan Valley of the Philippines, the country's main maize-producing region, suffered severe hardship when their already low incomes were slashed after a surge in maize imports in the immediate post-harvest period led to a 25 per cent fall in producer prices.[9] Similar threats loom today, as minimum quotas for imported maize are increased — in line with the GATT agreement — from 135,000 tons to 216,000 tons over the next ten years and tariffs on additional imports are reduced from 100 per cent to 50 per cent. At the same time, the liberalization of markets for wheat, soya and barley is increasing competition in markets for food and animal foodstuffs.

For its part, the Philippine government appears to

All Things Being Equal . . .

Free trade purists might view the loss of rural livelihoods through competition from imports with equanimity. After all, the classic argument for free trade maintains that trade liberalization will have positive effects, even if other countries are subsidizing their exports. In fact, the larger the subsidy, the better, since this will enlarge the scope for pursuing comparative advantage. Why produce food staples with a low value-added when you can import the same commodity at a giveaway price, freeing up capital and labour to produce higher value-added crops? What is the point, for example, of producing a ton of maize in Mexico if the same capital and labour resources can produce, say, enough flowers to cover the import costs of six tons of maize? Other things being equal, as the FAO has been at pains to point out, there is no point at all.

The problem, of course, is that other things, notably the distribution of assets needed to participate in export markets and the distribution of income from international trade, are not equal. In Mexico, the North American Free Trade Agreement (NAFTA) has created new opportunities for the export of fruit, vegetables and flowers, the production of which is dominated by large-scale commercial farms in irrigated areas. In value terms, the fruit and vegetable sector now accounts for about 40 per cent of Mexico's agricultural exports, but less than six per cent of its cultivated area. This points to the high degree of control over production and marketing which is exercised by national and transnational corporate interests. It is a similar story in Chile. Now the largest supplier of off-season fruit and vegetables to Europe and North America, over half of all fruit exports from the country are controlled by five transnational companies.

In Africa, too, the rapid expansion of fruit and vegetable exports is dominated by foreign transnational companies (in the case of Kenya and Zambia), or by powerful domestic commercial interests (in the case of Zimbabwe). It follows from the concentration in control over production and marketing that the benefits from international trade are also highly concentrated.

Restricting Access to Food

Turning to the interests of consumers, it is true that the foreign exchange generated by the commercial farming sector might facilitate an increase in food imports. But it does not follow that this will enhance the access of poor people to available food supplies, since this again depends upon distribution factors. To the extent that the commercial farm sector absorbs labour displaced in the staple food sector, it will provide some immediate income benefits. In many cases, however, these are minimal.

In Chile, the expansion of fruit and vegetable exports has gone hand-in-hand with the expansion of flexible labour markets — a euphemism for insecure, low wage employment. Over two-thirds of the labour force in Chile is now employed on a temporary basis. A similar pattern has emerged in Mexico, where workers on commercial farms are generally paid piece rates, are not entitled even to minimal social welfare protection such as sickness and maternity benefits and have no basic trades union rights. Such insecure employment is not compatible with household food security.

Household Concerns

At the household level, what is important is not an abstract distinction between "cash crops" and "food crops", or of production for export versus production for the local market, since most peasant households market both food and non-food crops to meet cash needs, while retaining part of the harvest for household consumption. Rather, the central issues are the distribution of productive assets and control over production and marketing.

The displacement of vulnerable smallholder producers, in a context where export opportunities are dominated by large-scale commercial farms, where opportunities for participation in markets are limited by inequalities in landholding and access to infrastructure, and where alternative livelihood structures are absent, poses an obvious threat of more poverty and food insecurity.

accept the demise of the food staple sector as an integral element in its own modernization plans. These envisage a reduction from five million hectares to two million hectares in the area planted to maize and rice, with the remaining three million hectares being diverted to cash crop production for export and livestock. Like FAO, the Philippine government appears to regard cheap food imports as the way to development. But while increased imports will help to facilitate industrialization, they will do nothing to address the food security problems which will accompany the loss of hundreds of thousands of rural livelihoods. One recent study suggests that half a million will lose their livelihoods.

Losers and Winners

Trade liberalization will create many losers, but there will also be some winners. Among them will be the corporate giants which between them control over three-quarters of world trade in cereals. These companies depend upon (subsidized) access to surpluses in Europe and North America and upon access to Third World markets to sell these surpluses. There is a confluence of elite interest here. Corporations want access to Northern surpluses for export to developing countries; Southern governments want access to cheap food for cities — and Northern governments need dumping outlets.

In the US, the dominant theme of farm policy is a relentless drive to expand export outlets in the South for the agricultural surpluses which the country continues to generate. Production from more than one in three acres in the US is exported in bulk or value-added form, earning over $54 billion in 1995. As a 1993 report from the US Department of Agriculture (USDA) stated:

> "Because the domestic market absorbs a smaller and smaller share of production, US agriculture must compete more and more effectively with other countries for share of world market — or else accept a reduction of productive capacity."[10]

The latter option is not one which policymakers or powerful agricultural trade corporations such as Cargill, the world's largest cereals trader, are willing to consider. Nor do they regard any alternative as commercially necessary. Drawing on the work of Lester Brown and the World Resources Institute, a recent Cargill corporation publication informed policymakers that market opportunities were limitless. In Asia and Latin America, the report suggested, food production had reached its environmental limits, with two-thirds of the 42 million acres of tropical forests being cut down each year to produce food. In contrast, it continued, the US had been paying farmers not to produce on more than 60 million acres, for conservation and supply management purposes, while supporting prices at levels higher than those on world markets. The lesson: withdraw supply management, lower the prices paid by potential exporters and force farmers to intensify production. To a large extent, these objectives were achieved when the 1996 US Farm Bill was passed.

The US will continue to produce surpluses and, as in the past, to pursue its strategic priority of developing markets where those surpluses can be sold. The focus of US farm policy is thus increasingly directed towards gaining a foothold in new markets — particularly in South-East Asia — in order to create food dependency in those countries. Such dependency used to be assiduously cultivated through the use of export subsidies, food aid and US trade power. To these strategies, increased trade liberalization has now been added.

Colonizing New Markets

The latest GATT agricultural agreement occupies a pivotal position in the US farm export strategy for South-East Asia. USDA estimates suggest that implementation of the agreement will create market opportunities totalling more than $3 billion. While the bulk of this market will be in higher value-added products, such as tinned beef and processed food to South Korea and Taiwan, markets for wheat and maize in Indonesia, the Philippines and Malaysia will also grow,[11] the latter having been carefully created by export subsidies. Between 1992-1994, the US Export Enhancement Programme provided over one billion dollars in subsidies to exporters to sell to Asia, with wheat accounting for 90 per cent of the total. Extensive credit subsidies have also been deployed to facilitate imports.

The USDA estimates that two-thirds of the increase in world demand for farm exports will take place in South-East Asia as a whole, with potentially enormous commercial interests at stake. Translated into financial terms, export earning potential will rise by around $14 billion by the year 2000, when the Pacific Rim region is expected to absorb over 60 per cent of US farm exports.

Free Trade and Mexican Agriculture

Mark Edwards/Still Pictures

Trade liberalization in Mexico under the North American Free Trade Agreement (NAFTA) provides a striking illustration of the threats facing vulnerable rural communities. Under NAFTA, which has to be fully implemented by the year 2008, the duty-free quota in Mexico for US maize imports has been increased from less than 1 million tons to 2.5 million tons. It will be increased again to 3 million tons by the year 2000. Tariffs on maize imports above this quota will decrease sharply after an initial breathing space, while restrictions on wheat and rice imports will be withdrawn in ten stages up to the year 2003.

As many as 2.5 million households in Mexico depend primarily on maize production for their survival, the majority working on ecologically fragile hillsides or on small, scattered plots. The crop accounts for over 40 per cent of the total cultivated area in Mexican agriculture and, more significantly, for almost two-thirds of the rainfed cultivated area on which the poorest producers are concentrated. Soil erosion in rainfed agriculture is more severe than in irrigated areas, because it is more frequently practised on sloping lands with poor soil. In a study covering ten of the main rainfed maize-producing states, the World Bank estimated that 22.7 million hectares were moderately or severely affected, with average productivity losses ranging from 37 per cent to 75 per cent. Productivity in rainfed areas is exceptionally low by comparison with the US, averaging between 2-3 tons per hectare as against 7.5 tons in the Mid-West.

Even allowing for differences in capital costs and income levels, Mexican producers will be unable to compete against US imports. According to a study carried out by the Mexican Ministry of Agriculture, four out of the six million hectares under rainfed corn would not be competitive under open market conditions. Only the large-scale irrigated sector would have any prospect of long-term survival without import protection. Under the current NAFTA scenario, another study has estimated that maize imports will rise by up to 200 per cent, with an attendant loss of around 2.4 million livelihoods. The negative effects — on employment, wages and income — will be concentrated in some of the poorest states, with the deepest levels of poverty. This will force vulnerable households from marginal areas such as Oaxaca and Morales into increasingly desperate survival strategies, including the migration of labour to the commercial farm districts along the Gulf of Mexico, the North Pacific coast, and lowland areas such as Michoacan. Shortages of farm labour will make maintenance of traditional intercropping and terracing systems unviable, adding to environmental problems.

The government of Mexico is providing direct income support to maize farmers during the transition to an open market under its Procampo programme. However, payments under this programme have been cut in the wake of the 1994 financial crisis. In the longer term, it is difficult to see how a temporary system of direct welfare payments could protect the interests of vulnerable maize producers.

For US exporters, the benefits are clear. Consider the blunt assessment of a USDA report on market potential in the Philippines:

> "In the absence of sustained, aggressive investment in infrastructure and increased competitiveness for corn production, the Philippines could become a regular corn importer by the end of the decade . . . US corn may be able to capture a large share of this growing market."[12]

The expectation of US policymakers — which in all likelihood will be met — is that import liberalization will accelerate considerably the conversion of consumer demand in South-East Asia from locally-produced staples such as rice, cassava and grains towards US wheat. As another report from the US Embassy in Manila to the USDA in Washington puts it:

> "Wheat is not an indigenous crop to the Philippines, nor is it currently viable as a commercial crop. However, wheat plays an increasingly important role in the Philippines grain market and is gaining on rice as a staple in the urban diet."[13]

The report celebrates the steep increases in consumer demand in the Philippines for rolls, pasta and noodles, anticipating significant new market opportunities for US exporters. In effect, South-East Asia is being sized up — and cultivated — as a dependent market for US food exporters.

Marginalizing the Many

Far from ushering in a new era for agricultural trade, the Uruguay Round of GATT marks the latest phase in the emergence of a global food system structured around powerful vested interests based in the North to the detriment of poorer people in the South. FAO's conviction that agricultural trade holds the key to global food security overlooks one crucial fact: international food trade has little or nothing to do with meeting human needs.

At a global level, the role of international food trade is not to ensure adequate nutrition but to meet effective demand — demand backed by purchasing power. That is why most food trade takes place between people who are already adequately fed.

A particularly striking example is provided by the trade in coarse grains such as maize; 60 per cent of this is directed towards the animal foodstuffs market rather than human consumption, a highly inefficient form of protein-to-energy conversion which means that wealthier people (who consume more meat) obtain more of the world's food output. Protein in the form of meat costs over ten times the price of protein provided in the form of grains and lentils. In Egypt, the per capita availability of protein and calories is higher than for all but three other middle-income countries, yet over one-quarter of Egyptian children suffer from moderate or severe stunting. The reason: Egypt's soils are used to grow more food for cattle than for people.

"Most food trade takes place between people who are already adequately fed"

At an international level, the problem of world hunger is not, and never has been, a problem of absolute shortage in the supply of food. Other things being equal, there is more than enough food in the world to feed everyone — more than one-and-a-half times more, according to the World Food Programme of the UN. Moreover, despite the current vogue for Malthusian predictions, (*see* Box, p.248), world cereals yields have consistently outstripped world population growth since 1980 (rising by about 2.2 per cent a year compared to a population growth rate of 1.7 per cent).

In a deeper sense, all this is of limited relevance. There is more hunger in the world today than ever before, with around one billion people living on inadequate diets. Whatever happens to the global food supply, that number is set to increase because of the very nature of the market economy: when access to food depends upon money, poorer people are inevitably excluded from food markets — and, by extension, from global food trade. International trade cannot change this in any meaningful way, since it responds to market signals rather than human need. But it can compound the problem. The surpluses generated by the capital intensive food systems of the North have a highly destructive effect on the food systems of the South, destroying livelihoods, depressing markets and undermining investment in agriculture. These in turn reinforce the very structures of poverty behind global food insecurity, eroding the capacity of people to grow their own food or to purchase it.

Towards an Alternative Agenda

As far as food security for the world's people is concerned, the need to press for an alternative agenda in world agriculture is clear. Under any circumstances, international trade requires careful regulation to prevent adverse food security outcomes; in a situation where markets are heavily distorted by Northern subsidies, the case for regulation is particularly strong. Confronted by an aggressive export promotion drive by the US and the failure of the Uruguay Round to address the issue of export dumping, how should the World Food Summit have responded? Most obviously, by turning FAO policy prescriptions on their head. Three strategic U-turns in particular suggest themselves.

First, the agricultural agreement of GATT's Uruguay Round should be renegotiated. The World Trade Organization (WTO), the body set up to replace GATT, should enforce a comprehensive anti-dumping provision, outlawing the use of direct and indirect subsidies to gain market share. More importantly, a new food security clause is needed in the WTO which would entitle all food deficit countries to protect their food systems up to the point of food self-sufficiency, if their governments so choose. There are sound social, environmental and employment grounds for such a clause, in addition to overwhelming food security considerations. It is surely unacceptable for the world's industrial countries (where farming now accounts for a tiny fraction of employment and national income) to transfer to the WTO the authority to dictate policies in a sector which accounts for over half the employment in most developing countries. This basic inequity is reinforced by an equally blatant double standard in that the US and the EU are now denying to the world's poorest countries the right to pursue many of the agricultural policies — including trade protection and farm price support — which they themselves pursued for the last 50 years.

None of this is to suggest that international food trade is inherently "wrong", or that autarky is desirable. Protectionist agricultural policies are not a panacea for problems of hunger or of poverty. But civil society, rather than remote trade bodies dominated by industrial countries, should determine the appropriate balance between the two.

The second strand for a new agenda to promote food security should concentrate on enhancing the capacity of smallholders to meet national and regional food needs locally, while increasing their control over production and marketing. This implies a broad range of public policy interventions, including redistributive agrarian reforms, strengthened tenancy legislation and a redirection of public investment towards staple food crops and more marginal areas. Investment in post-harvest storage facilities, rural feeder roads and research on food staples is especially important. So, too, is a commitment to the establishment of regional food security stocks capable of responding to fluctuations in supply and demand.

Finally, a clear signal should be sent to farm policy makers in Europe and North America that they must set their own houses in order. For too long, agricultural policy in the North has been dominated by vested interests. Raising productivity through the use of capital-intensive agricultural methods has been treated as an end in itself, regardless of market realities, social costs and environmental damage. True, there have been major beneficiaries ranging from chemical and machinery supply companies to big farmers and landlords. But the end result is there for all to witness. Hedgerows and woodlands have been destroyed, marshes drained, groundwaters poisoned and consumers left with health risks from pesticides in food. Biodiversity has been lost and

wildlife destroyed. Meanwhile, costly export subsidies, financed by taxpayers, have been used to dump surpluses overseas, destroying local markets and locking major exporters into recurrent trade wars and low price competition.

It is time for the public in the industrial world to question who benefits from Northern farm policies. Clearly, it is not smallholder farmers in either North or South. Mixed holding and small farms in the North are becoming a thing of the past; agriculture is more and more polarized between large farm businesses (which have reduced their costs of production by acquiring more and more land as a means of pursuing further economies of scale) and increasingly desperate small producers. In the UK, the number of cereals and dairy farms is around one third of the level in 1967, while average arable farm sizes have increased by over 20 per cent. The richest 20 per cent of farmers receive 80 per cent of CAP subsidies. In agriculture, as in other areas, public subsidies reward existing power networks rather than meet public needs.

It is time to stop thinking of agriculture in narrowly-defined economic terms and to develop approaches to agricultural policies which reflect wider ranging social and environmental priorities. Sadly, this appears to be the last idea on the FAO's mind.

Notes and References

1. Galbraith, J.K., "Agricultural Policy: Ideology, Theology and Reality Over the Years", mimeo of speech to National Governor's Conference, Harvard University, Cambridge, MA, 27 July 1987.
2. FAO, *International Trade and Food Security*, FAO, Rome, 1996.
3. In an impressively compiled table appended to a food security background paper for the Summit, the FAO's secretariat shows the correlation between per capita staple food production and net imports of cereals. Out of 93 countries examined, 51 registered a decline in per capita food production over the period 1972-1992. In most of them, food imports were considerably in excess of the 22 kilogrammes per person average for developing countries. Thus in Peru, to take one example, net imports accounted for 74 kilogrammes per person, compensating for a decline of almost one per cent per year in local production. The lesson drawn is that imports have played a vital role in filling the gap between production and demand.
4. FAO, op. cit. 2.
5. Overall, the industrialized countries transferred around $182 billion in the form of agricultural subsidies to producers who represent less than five per cent of their combined population. That sum was equivalent to more than 40 per cent of the value of agricultural output. Of this total, the United States accounted for $19 billion, and the 15 countries of the EU $74 billion. Expressed differently, each full-time farmer in the United States received a subsidy of $14,000.
6. The General Agreement on Tariffs and Trade (GATT), set up after the Second World War, is the main international forum for laying down the rules and standards governing imports and exports between countries. These rules and their scope have been revised through periodic negotiations, the most recent being the Uruguay Round, named after the country where talks were launched in September 1986. This was the first time that agriculture had been included in the GATT negotiations. Previously, the experience of the Dust Bowl in the United States and post-war hunger in Europe had persuaded policymakers of the need to protect farmers and to develop self-sufficient food systems. By the 1970s and 1980s, however, competition between the US and EU in world markets, where both were off-loading their surpluses, prompted the US in particular to push for liberalization in international agricultural trade through GATT as a means of restricting its rival.
7. The minimum import provisions have important implications for food security. Although the predominant staple in traditional diets is exempt from the requirements, several countries have more than one staple crop. For example, both rice and maize are food staples in the Philippines, as are beans and maize for much of Central America. In addition, imports of a crop such as wheat are competitive with other staples. The result is likely to be the undermining of staple food production.
8. According to the World Bank, the Philippines has the lowest ratio of public expenditure for agriculture to total expenditure and to GDP of any ASEAN country. *See* World Bank, *Philippines Poverty Assessment: A Strategy to Fight Poverty*, World Bank, Washington, DC, 1995.
9. Around half of the population in the Cagayan Valley and Central Mindanao, the main maize producing areas of the Philippines, live below the poverty line and are dependent upon maize for household food needs and for income.
10. Cited in *Cargill Bulletin*, Vol. 3, February 1995.
11. Indeed, for the US, gaining a greater share of the Asian market is now a major priority. It is not difficult to see why. The region currently accounts for about 40 per cent of US farm exports, and a positive trade balance of $29 billion. This is a region where overall US trade balance is massively in the red. Moreover, the scope for expansion is enormous. According to the USDA's Foreign Agricultural Service (FAS), wheat consumption in the South-East Asian region has increased by 50 per cent in the 1990s to over eight million tons. Between 1990 and 1994, the region's utilization of wheat rose by over 600,000 tons a year, and since virtually no wheat is produced in the region, any increase in future demand will automatically translate into increased imports. Regional production of rice and other coarse grains has increased at less than half the rate of consumption, with wheat imports filling the gap. By the end of the decade, the FAS forecasts annual wheat imports of 12 million tons and maize imports of 8 million tons — respectively a doubling and threefold increase. As the FAO concludes: "this region has the potential to become one of the primary forces driving import demand in the grain trade."

    Some of the national trends are particularly striking. In Indonesia, the region's largest cereals market, wheat imports were running at an average level of 2.5 million tons between 1990-1994. By 1998, they are projected to rise to seven million tons, largely under the impetus of a pot noodle industry which is one of the fastest growing food businesses in the world. In the Philippines, increased wheat consumption has been driven by consumer preferences for bread, rolls and noodles. Today, wheat consumption is around 80 pounds per capita, compared to 30 pounds in the 1970s. According to the most recent national nutrition survey, the average intake of grams provided by rice has fallen by five per cent since 1993, while per capita production of rice and maize has stagnated. In Malaysia, wheat imports have grown by over one third to around one million tons. Vietnam, one of the region's fastest growing economies and last untapped markets, is being closely examined by US commercial milling and wheat export interests.
12. US Department of Agriculture, *Asia and the Pacific Rim*, WRS series, 1994.
13. US Embassy Manila, *Agricultural Situation Report*, August 1995.

Transnational Corporations and Food

by

Sarah Sexton

The food industry has more companies in the world's top 1,000 companies than any other sector. In Britain, food and drink is now the biggest manufacturing sector. Only one of the world's top 60 food and drink companies lost money in 1995. As *Industry Week* pointed out (without a trace of irony), "feeding the world is . . . quite profitable".

Trade in foodstuffs is dominated by the US company, **Cargill**, the largest private company in the world; it not only trades but also transports and warehouses agricultural and other bulk commodities — grains, oilseeds, fruits, fruit juices, tropical commodities and fibres, meats, eggs, salt, petroleum, feeds, seeds and fertilizers — which it supplies to restaurants, food service institutions, grocery retailers, wholesalers and food manufacturers.

Cargill thrives on third country trade. From Singapore, Cargill's Asia-Pacific headquarters, the company trades in all types of agricultural commodities. Few of these are either produced or consumed in Singapore itself, but are shipped directly from producer countries to markets. Cargill's turnover from Singapore was $2.5 billion in 1994, of which less than one per cent landed in the country.

The fastest growing sector of the world's agricultural trade, however, is in processed food. In 1990, food which had been processed in some form accounted for 64 per cent of the international market in agricultural products. As one industry journal pointed out, "the success of protectionist policies in generating surpluses of many basic agricultural products may be creating many of the opportunities for food processors".

Globalization and urbanization go hand-in-hand with this growth: processed foods do not rot, have reduced preparation times and can be easily transported to people in cities. Global leaders in this market are the Swiss company **Nestlé**, Anglo-Dutch **Unilever**, and the **Kraft Jacobs Suchard** group, owned by tobacco giant **Philip Morris** of the US. The major food markets for food companies are within the developed world where major trends are:

- increasing concentration of both manufacturing and retailing;
- increasing competition between manufacturers' brands and private label brands. In Europe, supermarket chains are taking an ever-growing share of trade, aided by their computerized point-of-sale information and distribution systems, and central logistics. The inventories of Tesco and Sainsbury are a third the size of those of US retailers which often exceed 100 days supply.
- the perceived need to produce more ready-prepared, convenience foods of greater variety.

Concentration

Since the late 1980s, many of the large food and drink companies have been restructuring their manufacturing and marketing to focus on what they deem to be their core businesses. They have sold off parts of their businesses and taken over others in record numbers of transactions with deals of at least $500 million being the norm.

For some companies, such restructuring has involved drastic changes. In 1986, for instance, Allied Lyons, a name associated in Britain with cakes and coffee, acquired drinks company Domecq; in 1994, the company changed its name to **Allied Domecq**, dropping the Lyons. As its manager said, "Lyons brands now represent about two per cent of our profits and we are looking at the possible sale of our food manufacturing businesses". In 1996, British-based **Hillsdown Holdings**, the 12th largest food company in Europe in terms of sales of food and drink, acquired Allied's bakeries in The Netherlands, Germany, France and Belgium. Allied Domecq owns 13 of the top 100 spirits brands, including Teachers whisky, Beefeater gin, Courvoisier brandy and Suaza, Mexico's best-selling tequila.

Similarly, **Dalgety**, originally a London holding company with its roots in Australasian farming, has sold off many of its operations in Australia, Zimbabwe, the US and Canada to concentrate on the European food and agriculture business.

Patriotic feelings have arisen during this global restructuring. As *WorldPaper* wrote, "British society was shaken to its foundations" in 1988 when **Nestlé** bought up **Rowntree**, one of the country's long-established chocolate companies. The French group, **Danone**, described in 1995 by a *Euromoney* publication as "one of the most acquisitive French companies over the past year", bought up the British brands HP and Lea & Perrins, while US-based **Corn Products Company** acquired Bovril, Marmite, Brown & Polson, and Frank Cooper's Oxford marmalade. **Unilever**, the Anglo-Dutch company, recently acquired **Reckitt & Colman's**, the British mustard and malt beverage producer, but sold Colman's Robinson's barley water, celebrated for appearance at the Wimbledon tennis championships, on to British drinks company **Bass**.

But British companies have been doing the taking over as well. In 1988, **Grand Metropolitan**, whose portfolio includes Green Giant, Häagen-Dazs, and leading spirit brands Smirnoff, J&B and Malibu, acquired **Pillsbury**, one of the US's "oldest and best loved companies", making GrandMet one of the US's top foreign investors and the owner of BurgerKing. By 1993, the company had been fundamentally reshaped, according to its chair, from a predominantly British-based conglomerate of over 30 business into "a highly-focused branded international food and drinks business".

The acquisition in 1995 by **Cadbury Schweppes** of the US group **Dr Pepper/Seven-Up** was described as the biggest move for the company since the merger of Cadbury and Schweppes 25 years ago. "Our volume and share of the US soft drinks market has tripled", said chair of the company, Dominic Cadbury. "This jump in scale also means an increase in sales volume of our branded beverages worldwide of over 75 per cent". Renowned for its confectionery, a key company goal, according to Cadbury "is to be the largest and most successful brand owner operating in the non-cola sector of the worldwide soft drinks business". **Perrier** has sold most of its soft drinks to Cadbury Schweppes.

Half the global soft drinks market has been cornered by **Coca-Cola**, "the positive incarnation of US corporate capitalism", which had the highest profit margin in 1995 of all food companies — 16.57 per cent — compared to an average 6.98 per cent for the world's top five food companies. Most analysts agree it has won the cola wars against its long-standing rival, **Pepsico**, another of the world's top ten food companies. Yet soft drinks account for just one third of Pepsico's revenues, the rest coming from its snacks (Frito-Lay) and fast-food business (Pizza Hut, KFC Kentucky Fried Chicken and Taco Bell).

The French food group, **Eridania Beghen-Say**, acquired **American Maize-Products** in 1995, while **Unilever** entered the North American frozen foods market by acquiring frozen fish and seafood producer **Gortons** from **General Mills**.

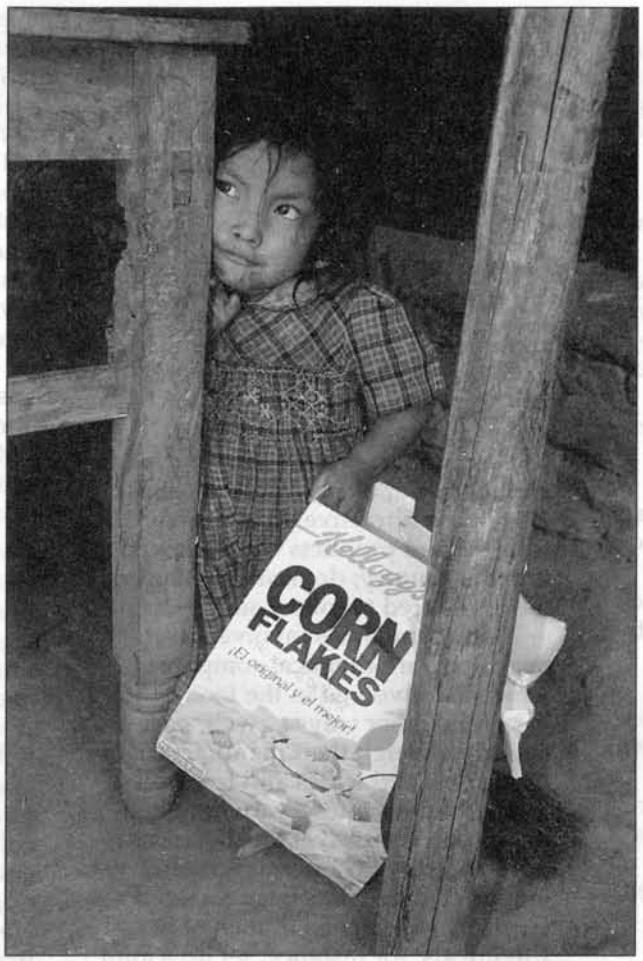
ConAgra, a leading diversified food company, is one of the fastest growing food companies, its sales and profits increasing every year for the past 15 years. It is the US's second processor of cattle for meat which it uses in its frozen foods and other products.

The key to future growth at **HJ Heinz** "is world leadership in the six core categories of food service, infant foods, ketchup and condiments, pet food, tuna, and weight control". Heinz president told shareholders that fast food chains were expected to double the number of their outlets by the year 2000 and "where these go, Heinz ketchup and Ore-Ida french fries will follow". He continued, "Like **McDonald's** and **Coca-Cola**, Heinz ketchup has become a global icon, known throughout the world".

New Products

In their drive for economic growth, food companies have tried to create new markets by manufacturing new products. **Bass** brewers, for instance, introduced Caffrey's Irish Ale and Hooper's Hooch, an alcoholic drink made with lemons.

"Functional foods" is one of these emerging food categories, according to US company **Kellogg**, the world's largest manufacturer of ready-to-eat cereal products. In 1996, the company decided to establish a Functional Foods Division to research, develop and market innovative foods that, it is claimed, will help consumers in the prevention and treatment of disease. The ingredients of many existing processed foods — salt, oils, sugars and chemical preservatives — are linked to the leading causes of death in industrialized countries, such as heart disease.



Nigel Dickinson/Still Pictures

Breakfast for an indigenous girl in Guatemala

New Markets

Many food and drink multinationals are looking for new markets in other countries, turning in particular to Asia, South America and Eastern Europe (primarily Poland, Hungary, the Czech and Slovak republics and Bulgaria). In these countries, they have been buying up food manufacturers, especially those involved in confectionery, biscuits, and meat, fruit and vegetable processing. It is easier and cheaper to buy a company with an established name and distribution network than to start from scratch.

French food manufacturer **Danone**, Europe's third top food and drink revenue earner and renowned for its yoghurt, is now the number one biscuit manufacturer in India, Russia, China and Argentina. "Danone must ensure that its brands are sold all over the world", says Chair and General Manager Antoine Riboud. "Some are frightened by this globalization effort. But just imagine the consequences if we were to abandon this potentially huge market to our competitors."

Cargill's Mexican subsidiary is due to start operation of a $30-million soyabean processing plant in 1997 to crush up primarily US soyabeans to produce vegetable oil and soyabean meal for Mexican markets. President of Cargill's Food Sector Guillaume Bastiaens said the project was "an excellent example of how Cargill, through the North American Free Trade Agreement, can help increase export opportunities for US grains and oil seeds . . . the true purpose of NAFTA". Cargill produces vegetable oils in 16 countries, a recent venture being the sale in Vietnam of oil produced in Malaysia.

The Czech Republic is a favoured target for multinational brewers because of its large brewing industry and the highest per capita consumption of beer in Europe. US-based **Anheuser-Busch**, the world's largest brewer and producer of Budweiser, is reportedly trying to crush a small Czech brewery, Budejovicky Budvar, because it produces "Budweiser Budvar", a beer named after the place where it is brewed — Budweis was the old German name for what is now Ceske Budejovice in southern Bohemia . The Czech beer is described by the UK Campaign for Real Ale as one of the world's great beers.

Much of Hungary's food processing sector, one of the country's strongest, has been bought up by US or European multinationals. **Nestlé** has bought confectionery factories, **Unilever** the country's only margarine factory; **Sara Lee/Douwe Egbert** and **Coca-Cola** have also invested. Italian multinational **Feruzzi**, which controls the agro-industrial company **Montedison**, acquired all six of Hungary's sunflower seed processing plants when it bought the state's Vegetable Oil and Detergent Company in 1992 for $100 million, making it the exclusive buyer of the crop. Just over a year later, Hungarian sunflower growers sued the country's State Property Agency over its handling of the privatization, arguing that the new foreign owners were using their monopoly position to lower prices paid to growers while letting retail prices rise.

The economic liberalization policies pursued by several developing countries have attracted back some companies whose operations in those countries were nationalized several decades ago. The Guyana Sugar Company, for instance, has contracted **Booker-Tate & Lyle** (the tropical agriculture joint venture between agribusiness group Booker and sugar manufacturer Tate & Lyle) to manage Guyana's sugar plantations which the multinational once owned.

Booker Tate is the world's largest contract manager of sugar cane estates, running farms in Guyana, Belize, Barbados, Kenya, Sri Lanka and Zambia. Trinidad and Tobago is the only sugar producer in the Commonwealth Caribbean in which Booker Tate is not involved. In both Guyana and Jamaica, multilateral institutions awarded financial assistance to the sugar industry as a result of management contracts being given to Booker Tate. A former company director who worked for 35 years in Africa, the South Pacific and the Caribbean said that bribes are often paid out of the commission to local representatives who have assisted in setting up a deal.

US and European companies clearly dominate global food markets. The only top 20 food company (in terms of turnover on agribusiness and food) that does not have its origins in Europe or the United States is the Thai-based **Charoen Phokpand**, whose interests include animal feeds, the poultry, pig and other meat industries, and aquaculture. With more than 50 feedmill and industrial plants in China, it has been estimated as the largest foreign agri-industrial investor in the country. It believes that its future growth will come from rising meat consumption worldwide.

Regional companies can also be influential. For instance, **Ceval Alimentos**, the second-largest food producer in Brazil and the largest grain processor in Latin America, provides food for 59 other countries. With the aim of doubling its revenues — $2.42 billion in 1994, Ceval has acquired other food companies in Latin America.

Packaging

As a result of increased trade liberalization, food packaging companies have experienced greater demand for their products. In Argentina, for instance, local demand for food packaging machinery has grown at an annual rate of over 10 per cent since 1991 when attractively packaged foreign food products were allowed into the country; domestic producers feel pressured to follow suit.

Many companies involved in packaging are chemical companies which are involved in the food chain in several other ways as well, particularly through their manufacture of pesticides, herbicides and fertilizers; food additives; preservatives (essential if food is to travel the distances it does and stay of supermarket shelves longer) and genetically engineered crops. The European branch of **Dow Chemicals**, for instance, set up a joint venture in 1996 with German coffee filter group **Melitta** to market aluminium rolls, dustbin bags and clingfilm for food. **DuPont** presents an international award each year for innovations in food packaging, including plastics recycling.

Global and Local

As a result of all these transactions, many companies' operations are no longer dominated by those in their home country. In 1995, for the first time, the UK was not the largest profit centre for **Cadbury Schweppes**. As *Euromoney* points out, Swiss companies such as **Nestlé** "have all but emigrated in terms of their capital, ideas and production . . . keeping a toe-hold in Switzerland only for reasons of brand-name and prestige".

Nestlé Brazil, for instance, is a leading manufacturer and retailer throughout South America of biscuits; most of its competitors are local rather than multinational. But as the president of Nestlé Brazil, Roland Meyes, pointed out, "We are the largest food company in Brazil . . . Yet few consumers in Brazil know we are Swiss. They think we are Brazilian or American."

Meyes pointed out the necessity of "acting locally" despite being a global company:

> "We tried to mutually create and share an advertisement between Brazil and Chile, but it was a flop; there were cultural differences, union problems with the artistes, and difficulties with the music. And strategies for some products will often vary by market. Developed countries have a high penetration of instant coffee . . . but in coffee-producing countries consumption is very low, so you can't pursue a single strategy for Nescafé worldwide. Even, say, Brazil and Colombia don't have all that much in common: in Brazil, we mainly take black coffee with sugar, while the Colombians generally drink theirs with a dash of milk."

Commenting on trade pressures, Meyes went on:

> "What is really new is that transnational retailers that we deal with here are starting to exert pressure outside Brazil when they don't get something within [Brazil]. In other words, they start to think local, and try to act global or international. [French-based food retailer] Carrefour asked us for additional extra discounts . . . and when I said 'No', it delisted most of our products for about four months. From carrying some 250 Nestlé items, it went down to about 25, most of them converted into loss leaders that it couldn't do without . . . Luckily, Carrefour still represents only about five per cent of our sales. What was different about this affair was that Carrefour delisted Nestlé temporarily, not just in Brazil, but also in France and other European countries, trying to apply pressure within a global context . . . Pricing policies and discounts are not something which simply can — nor should — be negotiated on a global basis. Existing problems have to be sorted out locally".

CGIAR
Agricultural Research for Whom?

Off-farm agricultural research plays a central role in shaping the current and future direction of agriculture. Who controls that research and who sets its agenda is of critical importance for food security. Of particular concern is the influence exerted by the Consultative Group on International Agricultural Research (CGIAR). Under its direction, research has been geared towards intensive, industrialized methods of production — at great cost to genetic diversity, the environment and poorer farmers in the South. Non-governmental organizations are pressing CGIAR to restructure its research agenda and decision-making processes to ensure the full participation of the South and to address the wider parameters of food security and livelihood systems.

For centuries, farmers have experimented with growing different plants, harnessing the amazing versatility of genetic combinations to produce crop varieties that best suited their needs. They have observed where and in what conditions their varieties flourish and selected for wider planting or further breeding those that are most resistant to pests, for instance, or that prosper in local soil conditions, fine tuning their adaptation to different micro-environments as they go. Such "barefoot" agricultural research is still the norm on many farms throughout the world.

But as more and more farmers have been encouraged (or forced) over the past few decades through government policies to adopt industrialized methods of agriculture — in particular, to use off-farm inputs such as chemical fertilizers, pesticides and commercial seeds — much of the research work which has historically underpinned improvements in farming systems has increasingly been transferred to specialist institutions far removed from the community. Such institutions have a profound influence on the way farmers farm, determining to a large extent what seeds are available for planting and under what conditions.

Whereas the seeds that farmers used to develop themselves were bred to reflect their own local needs, the seeds that farmers buy or are obliged to sow today have been designed to meet the institutional priorities of commercial plant breeders, agribusiness companies and multilateral finance and development agencies, often to the detriment of local needs. For instance, the Philippine government's recent programme to boost grain production so as to increase the country's self-sufficiency in animal feed forced farmers to use hybrid yellow corn seed from Cargill. In the southern corn belt of the country, these seeds failed dismally. The corn that did grow could not compete with feed imports, particularly as the new seeds required twice as much fertilizer as traditional corn seeds. In the process, soils are being degraded and farmers are losing control over their livelihoods. Agriculture Secretary Salvador Escudero laments:

> "We have always been under the gun of the multinational corporation. We are forced to get seeds from the two biggest seed companies . . . Any arrangement where the farmer is not given a choice is bound to fail."[1]

Off-farm agricultural research, as embodied in the seed, thus plays a central role in determining the current and future direction of agriculture. Who controls that research and who sets its agenda is of critical importance for food security.

This article was edited by **The Ecologist** from research material produced by **Genetic Resources Action International (GRAIN)** and the **Rural Advancement Foundation International (RAFI)**. GRAIN is an international NGO based in Spain which promotes the sustainable management and use of agricultural biodiversity based on people's control over genetic resources and local knowledge, with special emphasis on developing countries. RAFI is a Canadian-based advocacy NGO that has long monitored CGIAR activities.

Farmers as Innovators

Many books date the origins of agricultural research to sometime in the nineteenth century somewhere in Europe. It tends to be assumed that, before then, there was darkness and stagnation and farmers' livelihoods depended solely on the whim of different kinds of soil and climate and the availability of water. The crop varieties used in these dark times are considered to be the result of low levels of crop management employed by most traditional farmers.

This common view of the history of agricultural research completely overlooks the tremendous and spectacular achievements of hundreds of generations of farmers who developed agriculture in the first place.

Take rice, for example. Half the world depends on rice for their daily sustenance; ever since rice was domesticated in Asia some 8,000 years ago, farmers and local communities have developed well over 100,000 different varieties. Some grow under five metres of rainfall per year, others in the desert. Some do well with average temperatures well over 30°C, others flourish in fresh and cool climates. Some grow at or below sea level, others do well at high altitudes, for instance, in the Nepalese Himalayas. These different rices were developed conscientiously by rural folk through systematic observation, experimentation, intervention and selection.

Long before scientists were called "scientists", millions of anonymous farming families were actively engaged in the art and science of plant breeding. Plants have an incredible capacity to adapt to different conditions — varying amounts of daylight, water availability and temperature, and soil fertility. People have long manipulated this potential to serve their social, economic, cultural and political needs.

This agricultural research continues today all over the world. Mende farmers in Sierra Leone routinely conduct comparative field trials, testing new seeds against diverse soil types. Elsewhere in the country, farmers have developed 49 different rice varieties, each with a specific function in their widely varying agro-ecosystems. Peruvian farmers cultivate as many as 50 different potato varieties on their small fields for the same reason. Farmers all over the world have developed — and continue to develop — highly-sophisticated multiple-cropping systems that combine up to 20 crops in the same plot, thus optimizing resource use, conserving soil fertility and avoiding major pest problems.

CGIAR — Consultative Group on International Agricultural Research

Of particular concern is the influence exerted over agricultural research worldwide — and plant breeding in particular — by the Consultative Group on International Agricultural Research (CGIAR). Created in 1971 under the co-sponsorship of the World Bank, the UN Food and Agriculture Organization (FAO) and the United Nations Development Programme (UNDP),[2] CGIAR is an informal association of private foundations, international development agencies and over 50 governments, mostly those of developed countries. It has no formal legal status and takes decisions by consensus. Membership of the group requires payment of an annual fee of $500,000.

CGIAR members meet twice a year for a week or so under the chair of the World Bank to review CGIAR's work, set the forthcoming agenda and pledge funds for the work of 16 International Agricultural Research Centres (IARCs) dotted around the world.[3] Twelve of the IARCs work on key commodities, such as rice, wheat, maize and pulses; the other four attend to management-related research issues. All together, the centres employ 880 internationally-recruited scientists and some 11,800 staff. In 1995, CGIAR spending was approximately US$300 million; the research programme for 1997 is projected to cost $325 million.[4] Three-quarters of CGIAR's budget is contributed by OECD countries, the remainder largely coming from multilateral institutions, led by the World Bank, and regional development banks. In 1993, just over one per cent of CGIAR's funding came from Southern governments. The Group's budget is greater than that of UNESCO and comparable to those of FAO and WHO, while its staff complement far exceeds that of each of these organizations.

Although CGIAR's spending amounts only to between half of one per cent and three per cent of total global expenditure on agricultural research, this informal grouping with no clear governance structure and no status under international law has become a significant force in research into globally-important crops. Its leadership is pivotal in setting the research agenda for other institutions. This is especially the case with regards to the public agricultural research systems in developing countries which fine-tune many CGIAR outputs for their particular country. CGIAR's influence is further enhanced by its training programmes. It claims to have trained between 20,000 and 45,000 scientists from over 117 countries since the early 1960s. An estimated 35 per cent of all Third World agricultural scientists have had some training in an IARC.

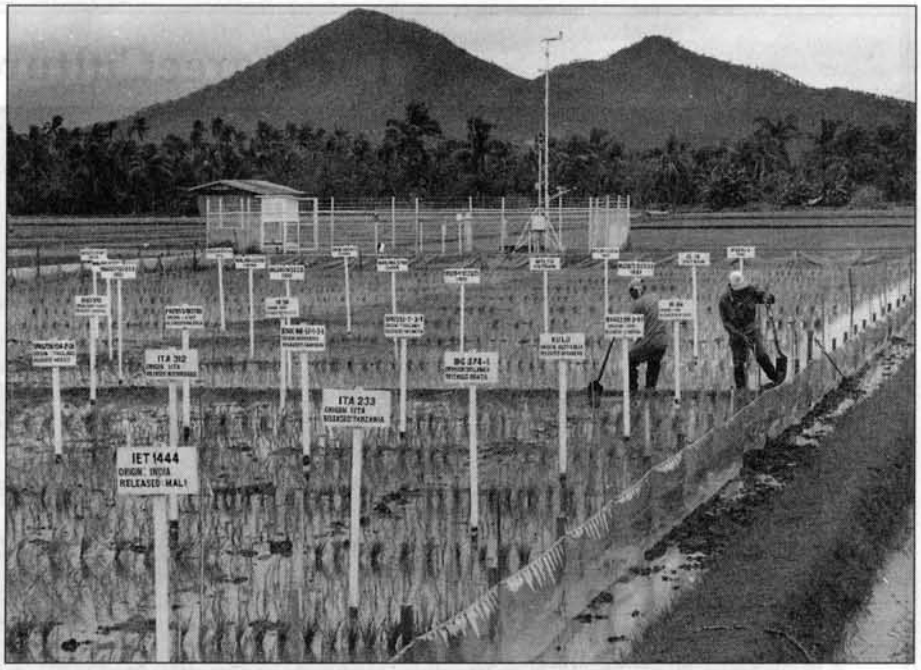
Control of the Group's research agenda rests largely with the 16 Directors-General of the IARCs and with the Group's Technical Advisory Committee (TAC). Four-fifths of these key posts are occupied by people from the North, as are three-quarters of the chairs of the main decision-making committees. In recent years, out of eight positions which became vacant — seven Director-General posts and the Chair of the TAC — only one was filled by a person from the South. More than half of all the top-echelon posts are now the preserve of Northerners from just four countries — the United States, Australia, Britain and Canada.

Cold War Warriors

Although founded in 1971, CGIAR's origins and concerns date back to the demise of direct European colonial rule in the 1940s and 1950s and to widespread fears among Northern policymakers that "burgeoning human

numbers" in the newly-emerging independent states of the South would lead to food shortages and demands for land reform and other "Communist" policies. Unless something was done to increase food production and control population growth in the South, the result was predicted to be increased starvation and Communist expansion (of particular concern since the establishment of the People's Republic of China in 1949).

The US-based Rockefeller Foundation set in motion the Northern response to these fears.[5] While busily distributing contraceptives in South Asia, it began to back agricultural research with a wheat breeding programme in Mexico. By 1962, the first Mexican high-yielding wheat varieties had been released, and by 1966, they had taken over 95 per cent of the area cultivated to wheat in Mexico. By 1969, wheat yields had increased more than threefold and Mexico had become "self sufficient" in wheat.[6] The goals of the researchers seemed to have been realized.



Heldur Netocny/Panos Pictures

IRRI's experiment fields for different types of rice from different origins.

The scientist responsible for developing these new crops in Mexico, Norman Borlaug, went on to Pakistan and India in 1963 to repeat the same approach. In 1967, new Pakistani wheats were ready for release, while the Mexican strains outperformed Indian varieties by 30 per cent.

In Asia, the Rockefeller Foundation teamed up with the Ford Foundation to establish the International Rice Research Institute (IRRI) in the Philippines in the early 1960s. In 1966, IRRI released its first variety of high-yielding rice, IR8, developed by cross-breeding a Taiwanese dwarf variety and a popular Indonesian one. Despite several serious drawbacks — IR8's grain was of poor quality and the variety lacked resistance to common rice diseases and pests — it was widely distributed because of its high yield potential. By the late 1960s, some 25 per cent of Third World rice land was planted with IR8 or similar semi-dwarfs. Miracle rice had joined miracle wheat in Rockefeller's supposed quest to overcome world hunger.

As momentum built up, both Foundations became convinced that seeds bred in one part of the world could grow successfully in another as long as they were developed in — and for — uniform systems of production and consumption, and as long as money was poured into a global plant breeding enterprise. By the late 1960s, having established the first IARCs, the Foundations had convinced World Bank President Robert MacNamara to take on the expanding project. In 1971, the Consultative Group on International Agricultural Research or CGIAR, came into being — a group of Northern donors aiming to support a network of agricultural research centres to boost food production throughout the South which would supposedly end hunger.

Benefiting Whom?

Although CGIAR's stated mandate is to increase food production in the South, the work of the IARCs[7] has substantially benefited agricultural development in the North as well. According to three members of President Clinton's cabinet in their (unsuccessful) attempt to persuade the US Senate to ratify the UN Convention on Biological Diversity, foreign germplasm contributes $10.2 billion annually to the US's maize and soyabean production.[8] They might have added that most of this germplasm comes from CGIAR research centres paid for by foreign aid, and that maize and soyabeans are just a tiny fraction of overall US benefits reaped from CGIAR.

Consider the US wheat crop. According to a 1996 study by one of CIGAR's 16 IARCs, the International Food Policy Research Institute based in Washington, DC, germplasm from another IARC, the Mexican-based CIMMYT which focuses on maize and wheat, can now be found in 58 per cent of the US wheat crop; its cash contribution since 1970 to US farmers is not less than $3.4 billion while that to the country's food processing companies is about $13.4 billion. The 1996 study conservatively places the economic gain for US consumers from IRRI germplasm, which now accounts for three-quarters of the US rice harvest, at about $1 billion since 1970.[9]

The US is just one Northern beneficiary of CGIAR. The Rural Advancement Foundation International (RAFI) has calculated that more than 80 per cent of Australia's and New Zealand's wheat crop is based upon CIMMYT breeding stock, along with 60 per cent of Italy's pasta and more than a quarter of the Canadian breadbasket. In total, RAFI places the annual benefit to Northern wheat production from CGIAR research centres at no less than $3 billion. IRRI's rice genes add another annual $655 million to this gain; beans from the Colombian-based research centre, CIAT, weigh in for another $111 million, while a cautious estimate for maize is about $29 million. These four crops alone give the North an annual return of almost $3.8 billion on a "foreign aid" investment of $300 million.[10]

Both CGIAR's critics and supporters acknowledge that the benefits of CGIAR research to the North go well beyond cereals and beans. The hairy potato developed by the Peruvian-based research centre, for example, confers broad disease resistance and will be planted from Australia to Europe. Likewise, germplasm from the same

The AgreeCulture

Mark Edwards/Still Pictures

CGIAR has long been dominated by Northern governments and interests

A striking feature of an annual CGIAR meeting — either the October gathering held in the IMF's auditorium in Washington to set the agenda for the coming year and determine its financing, or the mid-term May review held in different corners of the globe — is how unlike other meetings within the UN system it is.

Besides the donors ("investors" is a more apt term, given the flow of benefits), a large contingent from the 16 International Agricultural Research Centres (IARCs) is present, including the boards of trustees of each centre. So are scores of would-be consultants and staff of research institutes looking for financial support.

"Clients", the euphemism CGIAR reserves for those from the South, are seldom in evidence.

Virtually everyone speaks in English, invariably their first language; almost all the exchanges around the meeting room are conveyed with rapid-fire American accents or self-importantly British ones, in an Aussie twang or a self-consciously Canadian drawl. Interpreters desperately try to keep up for a largely theoretical handful of participants who might not understand.

Corridor conversations are more often tagged with the "nationalities" of University of California at Davis, Birmingham or Cornell.

Critics have dubbed the CGIAR system the "AgreeCulture", dominated as it is by MWASPs — Male, White, Anglo, Scientist-Patricians. Decisions for the world's largest and most influential agricultural research programme are made by a small band of people from a handful of agricultural colleges in Australia, Canada, Britain and the US, with no internal or external rules of governance.

research centre thwarted golden nematode damage to Northern potatoes. The Colombian-based centre, meanwhile, has identified and shipped forage grasses and forage legumes from Latin America, the Caribbean and East Africa to bolster Australia's livestock industry. Germplasm and research from the Indian-based International Crops Research Institute for Semi-Arid Tropics (ICRISAT) has yielded drought-resistant sorghums in Texas and a new and thriving chickpea industry in Australia. Meanwhile, livestock research at the International Livestock Research Institute in Kenya has increased goat milk yields in the United States and protected cattle from diseases throughout the industrialized countries. Cowpea and sweet potato germplasm from the International Institute of Tropical Agriculture (IITA) in Nigeria is now contributing to US farms and forming the basis of a new snack for transnationals to market.[11]

Many CGIAR officials simply regard benefits such as these as a fortunate spin-off of South-focused research. At times, however, the Northward flow seems to be more of a haemorrhage. In recent years, three-quarters of ICRISAT's chickpea gene exchange and close to one third of CIMMYT's triticale (a cross between rye and wheat) have gone North. As much as one third of the annual outflow of tropical seed samples from CIMMYT now ends up in the hands of transnationals like Pioneer Hi-Bred and Cargill.[12] Pioneer Hi-Bred obtained hybrid maize from the Nigerian IITA centre, the product of research financed directly by the Nigerian government, and is now marketing it from Zimbabwe to Thailand. Cargill, meanwhile, is commercializing IITA's inbred maize lines in East Africa and Asia.[13] At least four CGIAR varieties are "protected" in the US or Europe under a plant specific form of patent.[14]

Whose Germplasm?

The ultimate source of this Northern flow of benefits — germplasm — lies in CGIAR gene banks. From its inception (but particularly in the 1970s and 1980s), the CGIAR research centres, operating under the banner of the UN and the auspices of FAO, collected half a million seed samples from farmers' fields throughout Africa, Asia and Latin America. While the centres today may hold just 13-16 per cent of the total crop germplasm stockpiled worldwide, the IARCs' germplasm constitutes about 40 per cent of the unique, farmer-bred seeds that are vital for crop improvement.

The centres have a scientific (if not moral) obligation to duplicate their collected samples in at least one other gene bank for safekeeping. About two-thirds of samples have never been replicated; the ones that have been invariably went to banks in the North even though newer and less crowded facilities were usually available closer to hand in the South. CGIAR's supporters maintain that no more than one fifth of all seed samples exchanged by the IARCs ended up in OECD countries. Since these countries make up less than one fifth of the world's countries — and since the research is supposed to be on tropical and sub-tropical agriculture — this assertion is of little comfort.[15]

In the late 1970s, Southern farmers and their governments began their struggle to regain control over the crop germplasm they themselves had nurtured. It seemed as if some progress had been made when the UN adopted the Convention on Biological Diversity at the 1992 "Earth Summit". However, the Convention expressly excludes responsibility for any biomaterials collected *prior* to its coming into force in late 1993. Thus collected plants, animals and fungi belong to whichever country they were in at the time the Convention became law, irrespective of where they originally came from. Of the world's germplasm that is catalogued and available for scientific and commercial investigation, two-thirds of the crop germplasm and more than 85 per cent of the livestock and microbial material is banked in the North, even though almost all of it originates in the South. In effect, virtually all the diversity known to exist and believed to have financial value lies *outside* the scope of the Convention. Its mandate is restricted to the uncollected and uncatalogued biomaterials not yet known to exist which may never have commercial value, or at least not for many decades.

With biotechnology companies, which are largely based in the North, now actively seeking Southern germplasm, the commercial benefits to the North of this arrangement are inestimable. As private companies move into the South's seed markets, farmers risk having to pay each year for the end product of their own centuries-long research. The entire operation is fast becoming a "klepto-monopoly", transforming freely-given germplasm from the South into patent monopolies for the North.

Of Breeding and Biases

None of this is to suggest a conspiracy by the North to impoverish the South still further, nor to suggest that agricultural research in one part of the world should not have benefits to those elsewhere. The reality is much more complicated than dollar figures can ever suggest. Nonetheless, it is an inescapable conclusion that the CGIAR system, long portrayed as a way of benefiting food production and poor farmers in the South, provides tremendous benefits to the North by channelling Third World germplasm to Northern plant breeders. Some critics argue that there is nothing inherently wrong in this — provided that Southern farmers and other informal innovators receive compensation for their centuries of research, which at present they do not. More broadly, they point to the urgent need for CGIAR to restructure its research agenda and processes so that small-scale farmers regain control over the direction of agriculture, including the direction of research and technology.

This is unlikely to be achieved without major reform. Since its inception, CGIAR has tended to view agriculture and agriculturalists in the South as "problems". Rather than building upon and improving locally-generated indigenous techniques, agricultural research within the IARCs has been inherently geared towards replacing them through the workings of "modern science". From the outset of the Green Revolution, the very existence of indigenous agricultural technologies and expertise was totally ignored — a blind spot that still persists within CGIAR. When Rockefeller associates came back from a fact-finding mission in India in 1952, for example, they concluded that India's people were "enslaved by centuries of tradition and . . . [are] not truly free to try new methods or to exploit their own ingenuity". They therefore act on impulse rather then reason:

> "The villages are as uniform as so many ant hills. Indeed, from the air, where a number of villages may be seen simultaneously, they have the appearance of structures built by creatures motivated largely by inherited animal instincts, and devoid of any inclination to depart from a fixed hereditary pattern."[16]

A belief in overpopulation, combined with a perception that people are inherently resistant to change, called for *universally applicable* scientific solutions to be brought in from outside. One result was the downgrading of research on varieties adapted to specific local realities. When IRRI was set up, for example, the Institute's leaders "persuaded senior Philippine government officials that IRRI would do such a good job that building national research capabilities on rice need not be a high priority".[17] As a result, the Philippines effectively stopped all rice research for nearly three decades, until pressure from farmers for nationally-appropriate crops led to the creation of the Philippine Rice Research Institute in 1985. In Sri Lanka, which one observer described as having "the most sophisticated research structure of any country", superseding even that of the United States, the first IRRI representative urged the government to phase out its rice research on the grounds that IRRI could supply all the new varieties needed. With IRRI came a whole new approach to research:

Impacts of the Green Revolution

In 1993, the UN Food and Agriculture Organization published a six-point summary of what was wrong with agriculture in the world. While FAO is not well-known for promoting the soundest agricultural strategies in developing countries, its critique of widespread trends is succinct: monocultures are unstable; arid and semi-arid zones have been ignored; plant breeding is too focused on major commercial crops; there is little emphasis on minimum till systems and heavy recourse to mineral fertilizers; and soil erosion control overtaking management of soil humidity. FAO continues:

> "These consequences are now of general acceptance, and are increasingly being faced by research and extension systems."

Soil Erosion

According to FAO, 25 per cent of agricultural land worldwide — arable land, permanent cropland and grains land — has been degraded through mismanagement. Stripping the land of its protective vegetative cover, the use of heavy machinery, continuous monocropping, disregard for soil conservation practices, cutting trees in the fields, loss of soil organic matter and life — all result in increased soil erosion. Industrial agriculture has promoted all these practices with the concomitant erosion of agricultural biodiversity and breakdown of agro-ecosystem stability.

Water Degradation

Closely linked to soil degradation is the mismanagement of water resources. Agriculture in general accounts for 73 per cent of total worldwide water consumption; about ten per cent of the planet's irrigated lands have been lost or severely damaged by intensive practices leading to salinization, alkalinization and subsidence. Abundant water is one of the necessities of many high-yielding crop varieties if they are to produce their high yields; its lack has become a major constraint to sustaining initial dramatic yield increases. To provide these huge amounts of water, massive dams and reservoirs have been built, usually entailing short-term benefits and long-term negative effects.

Chemical Inputs

Another precondition of the Green Revolution's promised yields is the need for massive doses of synthetic fertilizers and agro-chemicals, which are expensive and environmentally harmful. In India, the combined production and import of synthetic fertilizers grew by over 3,000 per cent between 1952-3 and 1975-76, from 107,000 tons to nearly 3. 4 million tons.

The developing countries that embraced the Green Revolution spent vast resources during the 1960s and 1970s on the import, production, subsidy and distribution of such fertilizers, assisted by massive international aid transfers. When these subsidies stopped or were severely cut back during the period of IMF-imposed structural adjustment and overall economic crisis during the 1980s, farmers who had become hooked on the quick nitrogen-phosphorus-potassium fix suddenly found themselves with eroded, impoverished and intoxicated soils — and no resources to buy any more chemical fertilizers.

Reliance on chemical pesticides has added to the environmental and health hazards caused by the Green Revolution. The wisdom of massive pesticide use as a pest control strategy and as a way of increasing yields has been questioned by many. Director of ICIPE Thomas R. Odhiambo cites the example of US agriculture:

> "It appears that losses caused by insects have, surprisingly, increased nearly twofold (from seven per cent of crop yields in 1945 to about 13 per cent in 1989), even though the application of insecticides has increased more than tenfold during the same period."

Biological diversity specialist Norman Myers points out that:

> "about one half of the 500 species of insects, which inflict US$2 billion worth of damage on US crops annually, have developed resistance to insecticides."

Green Revolution monocultures have replaced well-adapted agro-ecosystems which grow a wide array of crops that are resilient to pest damage. Through long standing practices and the use of selected resistant varieties, farmers had achieved fragile but effective balances that avoided or reduced crop losses. Pest control hinged not only on remedial aspects, but on soil, plant and field health, and stability. The introduction of a technology that disrupted those delicate balances led to increased pest damage and pesticide use.

Genetic Erosion

The genetic base of most crops, especially major commodities, has been tremendously eroded through the displacement of biodiverse farmer varieties by the "miracle yielders" of the Green Revolution. Rice and wheat have probably been the hardest hit.

In 1990, modern rice varieties

> "Where Sri Lanka started from the land and the environment, IRRI started with the rice plant. Where Sri Lanka built on local varieties, IRRI sought a universal solution. Where Sri Lanka examined the potential of many different crops, IRRI concentrated on irrigated rice . . . Where Sri Lankan rice science training was built on the analysis of the needs of the country, IRRI's training was conceived in terms of a universal, abstract science that would solve the food-shortage problems of Asia."[18]

A further bias central to the direction and impact of IARC research has been its almost exclusive focus on the *yield* of single commodities. Convinced that the way to solve the problem of too many hungry people is to produce more food, the forefathers of the Green Revolution saw "yield" simply in terms of kilogrammes of grain per hectare. Little or no attention was paid to the diverse uses to which crops are put or the complementary crops that farmers have long harvested alongside their main crops. Rice paddies, for example, have traditionally provided much more than grain: other harvested "crops" include fish, shrimp, crab and other animals, edible herbs, straw for manure and buffalo feed, and medicines. This "hidden harvest" (much of which was lost to the Green Revolution) is seldom taken into account when data on the yields of Green Revolution varieties are compared with traditional varieties. It has

covered 74 per cent of Asia's rice lands. In some countries like Sri Lanka, the Philippines, China and Malaysia, the sell-out to new strains is now nearly total. A few decades ago, Indian farmers were growing some 50,000 different rices; today, they grow just a few dozen. Likewise in the Philippines, some 4,000 different varieties were once grown, but now farmers only plant a few across the country. In Indonesia, 1,500 local rice varieties have become extinct in the last 15 years.

IRRI played a major part in this loss of diversity in Asia's rice fields. By the late 1960s, IRRI's IR8 and other semi-dwarfs covered 25 per cent of the Third World's rice area. By 1986, this figure reached 55 per cent.

Some genetic diversity will always be lost in normal agricultural practice as a result of changing needs and tastes, unusual climatic stress, political upheavals and contact with other communities. But the speed at which the contemporary rate of genetic erosion is taking place is unprecedented. The main reason for such loss can be traced directly to the Green Revolution's yield bias and the introduction of standardized high-yielding varieties with little concern for the long-term effects of substituting for traditional varieties.

Additionally, the kind of conservation strategies promoted by CGIAR are partly to blame for a reduction in global biological diversity. For three decades, CGIAR has spearheaded the drive to promote one kind only of conservation strategy: *ex situ* conservation. Gene banks, the high-tech approach to conservation, are expensive, suffer power shortages, lack trained personnel and often may not conserve what was supposed to be conserved. Seeds die in cold storage and undergo genetic changes when grown out in fields and conditions different from those from where they were collected. Just five years ago, a survey of the US national germplasm collection at Fort Collins, one of the largest national collections in the world, revealed that less than one-third of the seed samples were healthy. The other two-thirds either contained too few seeds (45 per cent), had not been tested for viability (20 per cent) or were "dead or dying" (8 per cent).

C Fornari/FAO

High-yielding wheat (right) developed at a Brazilian research centre produces more grain than a local variety (left) but less overall yield.

Only one-third of IARC germplasm accessions appear to have a duplicated back-up at another gene bank, according to a recent review of the IARCs. Of material that was (probably) backed-up, one-quarter of all samples were stored under technically inadequate (or, even, unknown) safety conditions.

The review also exposed the muddled legal status of back-up collections. Less than nine per cent of all IARC collections were safely replicated and stored on the basis of written agreements between the IARC and the recipient gene bank. Thus, the country receiving the collections (usually located in the North) was free to regard the seeds as their own and to do with them as they pleased.

The review raised doubts about who was being served by the IARC gene banks. Although CGIAR claimed to be shipping hundreds of thousands of seed samples throughout the world every year, data revealed in the review showed that almost half the distributions of seed stocks went to other IARCs and international agencies. One-third remained within the host country, and only one-fifth went to other countries.

There was also considerable financial confusion. Although the CGIAR system claimed to spend about $23 million per annum on seed conservation, NGO researchers could only identify, optimistically, $15 million. Individual IARC expenditures were also wildly inconsistent — ranging from barely $4 per accession to more than $200.

been argued that if *total* yield were taken into account, traditional systems would fare much better in comparisons with high yielding varieties.

Compounding the commodity yield bias is the emphasis some IARCs have placed on fine-tuning their mandate crops to growing in the more favourable environments. For instance, far more attention has been paid to researching crops for irrigated lowland systems than for more fragile and diverse uplands. IRRI has long directed well over half its annual budget to rice destined for the fertile irrigated lands where farmers have better access to credit and marketing facilities, because it assumes these lands and farmers will feed the growing cities.[19]

CGIAR's focus on increased commodity production has also completely — and deliberately — overlooked questions of distribution, including issues of why cities are growing and why the poor remain poor. As has become clear in recent decades, increasing food production does little to feed people if they are denied access to the food produced — either because they are unable to grow it for themselves or because they lack the wherewithal to buy it. Ensuring access to food requires that action be taken to redistribute power and resources — issues which the architects of the Green Revolution were eager to avoid in their quest to find technical solutions to the politics of hunger.

Renewal or Revolution?

As CGIAR has no constitution, rules or legal personality, governance tends to rest with an invisible "IARChy", an informal association of the Directors-General of the 16 IARCs (each with a legal identity and board) and those who chair the boards.

To spruce itself up for the 1992 UN Conference on Environment and Development (UNCED) — the "Earth Summit" — CGIAR expanded itself to 18 IARCs and added on forests, fish and bananas to its new-found "green" agenda. At a time of flagging enthusiasm for aid in general and agriculture in particular, however, the move was a disaster. Within two years, donor support plummeted 21 per cent (US financing fell 40 per cent), 2,000 people were struck off the employment rolls, and four IARCs had to be rolled into two. The invisible IARChy concluded that it had been a little too invisible to attract sufficient attention from OECD donors.

When World Bank Vice-President Ismail Serageldin, an Egyptian, took up the post of Chair of CGIAR in 1994, he called for an 18-month period of renewal. A high-level meeting of potential donors was convened in Lucerne, Switzerland, in early 1995.

If funding topped the renewal's agenda, governance issues were not far behind. In an Open Letter to those attending the Lucerne gathering, NGO critics urged governments to undertake a full external review of the programme and management of the entire Group. CGIAR officials replied curtly that CGIAR had moved beyond such blunt tools of assessment and that evaluations of CGIAR's performance were being conducted — in undefined ways.

The last external review, commissioned in 1981 by donors, noted that the role of the South in governance of CGIAR needed improvement. At that time, almost 54 per cent of IARC board trustees were from the South. By 1986, the proportion was less than half, and has slipped lower ever since.

Despite exhortations from Serageldin to move governance Southwards, every key post that became vacant during the 1994-1995 "renewal" period went to a Northerner. When a new Chair of the powerful Technical Advisory Committee (TAC) was required, someone from the US was chosen. When the posts of Director-General came up for the Philippines-based centres focusing on rice and aquatic resources (IRRI and ICLARM), the Mexican-based maize and wheat centre (CIMMYT) and Colombian-based tropical agriculture centre (CIAT), a US citizen took one and Australians the other three — leading some commentators to wonder if CGIAR had misunderstood the political term "South"!

When these appointments were criticized by Scandinavian governments, amongst others, a Norwegian was appointed as Director-General of the International Service for National Agricultural Research, the one IARC specifically charged with strengthening the participation of the South in research. Overall, since the beginning of the "renewal", the North's control of key positions has risen from two-thirds to three quarters. (Since 1989, the percentage of women on the IARC boards of trustees has incrementally increased every year to its current level of 20 per cent.)

By the time of CGIAR's annual gathering in October 1995, the decline in the South's participation had been well-documented by critics; delegates could not avoid the charts and tables sent to them in their Washington hotel rooms. Reluctantly, it was agreed that an external review was unavoidable.

Such a review will begin sometime in 1997. CGIAR also appointed an NGO Advisory Committee, but half its nominated members refused to serve and several others have resigned.

At the 1996 annual Washington meeting, CGIAR supported the creation of a "forum", formally a non-CGIAR institution that might convene every two years to bring together agricultural researchers from South and North to consider their collective progress. This "forum" is an attempt to avoid pressure to push CGIAR inside the UN system by giving it a more pluralistic (one country, one vote), although still informal, governance structure.

After a quarter of a century as an invisible IARChy, CGIAR is finding it hard to come to terms with the needs of farmers and national research programmes. Rather than "renewal" from the inside, it will take a revolution to alter fundamentally the institutions themselves and their governance. The next agricultural revolution has to come from outside.

Sustainability?

Thirty years after the beginning of the Green Revolution, CGIAR is under intense pressure from both its members and its critics to change its agenda. Following a two year "renewal process" in the early 1990s, the Group now claims that it is "refocusing" its research. In future, more attention will be played to ensuring "sustainability" and encouraging "farmer-centred research". Its "new" mission includes promoting sustainable agriculture for food security in developing countries.[20]

But CGIAR's underlying focus seems to have remained the same. The Group continues to pay little more than lip service to the social, economic, cultural, political and interpersonal dimensions of food and farming, blaming environmental destruction and world hunger on population growth only.[21] As in the past, increasing production through more intensive, industrialized agriculture, aided now by genetic engineering, is seen as the only solution.

According to CGIAR's Technical Advisory Committee, low- or non-external input systems are inherently unsustainable, since they are judged to be incapable of feeding a growing population. The starting point is that "systems using no external inputs eventually deplete soil nutrient reserves, reduce vegetative cover and leave soil exposed to degradation".[22] "Sustainability" thus demands that old "closed" systems be replaced by "open production systems" — open to external inputs and to surplus production. In areas where farmers cannot afford external inputs, alternative approaches, such as nutrient recycling, nitrogen fixation and agroforestry, should be adopted to "sustain a moderate level of production and limit degradation".[23] In better endowed areas, by contrast, "high levels of external inputs are necessary to sustain high levels of production without depleting soil fertility".[24]

Casting low or non-external input systems as inherently unsustainable turns the world upside down. The world's current preoccupation with sustainability started not because traditional farming systems "failed", but because the Green Revolution — in merely half a century — is destroying agriculture. Propelled by CGIAR-styled research in developing countries, Green Revolution farming is undermining the resource base by depleting croplands of genetic diversity, degrading soils, eradicating farms and polluting precious water supplies. Ironically, formal sector researchers are now rediscovering "traditional" practices such as intercropping, biological pest control and soil management strategies as sound ways forward to improve sustainability in "modern" agriculture.

The assumption that low external input systems are inevitably low yielding is also questionable. Grain yield may indeed be lower but measuring only the one output of the main crops grown by farmers is highly misleading. Nor, contrary to CGIAR's claims, are increased yields dependent on extending the Green Revolution.[25] Indeed, recent research indicates quite the opposite: while yields of "modern" varieties are stagnating or declining, "evidence is accumulating that . . . for much CDR [complex, diverse and risk-prone] agriculture, present production is far below its sustainable potential."[26]

Gene Revolution

This is not to say that there are no sustainability problems in specific traditional low external input agricultural systems. Nor is it to imply that science could not provide a helping hand. But more sophisticated and inclusive strategies should be considered which seek to enhance the productivity of traditional agro-ecosystems by building on and extending local technologies and strategies.

Instead, CGIAR is pushing such systems towards a Green Revolution replay by spearheading research into the genetic engineering of crops. In the Philippines, for example, IRRI is conducting research into a new "Super Rice" which, it is claimed, will produce 15 tons per hectare — 25 per cent more than conventional high-yielding varieties. According to IRRI's principal plant breeder, Dr. Gurdev Khush, the new "15-tonner" will need no additional fertilizers and "will produce its own herbicide", presumably through genetic engineering. Other superbreeds being developed at the IARCs include super cassava, which yields ten times more than traditional varieties, and super tilapia, a fish which might do well in the super rice paddy fields.

Little or no research has been conducted on the ecological impacts of such crops; their potential to reinforce social and economic inequalities by benefiting richer farmers and corporate interests over poorer farmers has been entirely overlooked. Yet the gene revolution is rapidly accelerating the trend towards corporate control over production — and it is poorer farmers and the environment which will suffer.

In the maize sector, for example, control over new genetically-engineered varieties already rests with the world's largest transnational corporations, which have been active in researching and patenting new biotechnologies, often using CGIAR varieties. Some 93 per cent of all maize field tests in the United States were carried out by ten companies, all major multinationals. Corporate breeding is moving maize further and further away from being a food in its own right, transforming it instead into a raw material for industry. Twenty-five per cent of patent applications for genetically-engineered maize, for example, involve techniques to modify the quality of maize, the bulk of research being on increasing its starch content, the base for many industrial applications.[27]

Whereas farmers used to work with broad genetic complexes to improve their integrated agricultural systems, today microscopic genes have become the raw material for a growing billion-dollar transnational biotechnological industry. In this context, the status of IARC seed banks and the governance of the entire CGIAR are of critical importance. For whoever controls the breeding agenda — and access to the genetic resources which make breeding possible — is in a position to control the future direction of agriculture.

A New Agenda

There is an urgent need to reorientate CGIAR's research agenda so that it supports efforts for a truly participatory sustainable agricultural development. Non-governmental organizations monitoring CGIAR are pressing the Group to adopt five principles as the minimum requirements of any new Consultative Group on International Agricultural Research:

- **Farmer First**

  The starting point of international agricultural research must be the well-being of the farming community. This means returning leadership in research to farmers through a creative process of dialogue and debate and through their full participation at every level of the research process. In recent years, CGIAR has tended to drift away from farmers and to define their target group as the urban poor. While there is no doubt that agricultural research must also result in food security in the cities, the only sure route to this is through the empowerment of food producers in the countryside.

- **A Wider Vision**

  A new Consultative Group must broaden its focus from narrow commodity-based research to address the wider parameters of food security and livelihood systems. It has to consider agriculture in its entire complexity rather than reducing it to simple uniformity. It must focus on plant breeding and productivity in the overall context of community management of livelihood systems.

- **Diversity**

  Through its governance structure and in its day-to-day activities, any new Consultative Group must

Common Heritage or Private Property?

The concept of Farmers' Rights arose out of the asymmetry in the global exchange of plant genetic resources. By the 1970s, much of the South's plant genetic resources, particularly of the main cereal crops (wheat, maize, barley and sorghum), were being housed in genebanks which were either based in or under the control of the North. In addition, Northern seed companies had acquired property rights over varieties developed from such resources — Plant Breeders' Rights had been enshrined in international law since the 1961 International Convention for the Protection of New Varieties of Plants (the UPOV Convention).

Thus in 1983, under pressure from Southern governments, a resolution was passed at the 22nd session of the UN's Food and Agriculture Organization establishing the International Undertaking on Plant Genetic Resources, a non-binding legal framework defining the conditions of exchange, access and utilization of plant genetic resources.

The Undertaking was based on three basic principles:

- **Common heritage**: plant genetic resources are a heritage of mankind and consequently should be available without restriction.
- **Wide understanding of plant genetic resources**: These included not only cultivated varieties in current use but also obsolete varieties, primitive landraces, wild and weed species, and special genetic stock, including elite and breeder lines.
- **Unrestricted access**: Access to plant genetic resources will be free of charge on the "basis of mutual exchange or on mutually agreed terms".

Another resolution at the same FAO session led to the formation of the Commission on Plant Genetic Resources to implement the Undertaking, in particular to monitor the exploration, collection, conservation, maintenance, documentation, exchange and use of plant genetic resources.

Northern Opposition

Unsurprisingly, there was stiff resistance from Northern governments to the Undertaking; several countries logged their reservations to it.

The seed industry made clear its opposition to the free access of their material. As a US seed company representative, William Brown, stated in 1988:

> "to ask that an elite parental line which costs a company several hundred thousand dollars to develop be exchanged for cultivars of limited or unknown potential is simply not reasonable, and seed companies will not agree to such an arrangement."

The seed industry also maintained that "primitive cultivars" were "natural", requiring little if any investment and activity on the part of developing countries or their farmers and hence should be treated as "free gifts of nature". They argued that such resources should not be subject to any form of property rights — in contrast, of course, to breeders' materials. Neil McMullen of the Washington think-tank, the National Planning Association, held the position that:

> "[Developing countries] do not have to work to acquire the genetic diversity they possess, whereas breeding programmes require years of efforts and large commitments of resources."

This contradiction of maintaining private property rights for the "inventions" of the seed industry while insisting on unrestricted access to traditional cultivars and farmers' varieties without recognition of or compensation to their developers characterized much of the opposition during the 1980s to the Undertaking, preventing action being taken on genetic erosion and the inequity of germplasm exchange.

Undermining the Undertaking

In 1989, a compromise struck between Northern and Southern governments "aimed to improve the participation of countries in the International Undertaking". The South agreed to the Undertaking being interpreted in such a way that plant breeders' rights were regarded as compatible with the Undertaking, thereby superseding the principles of common heritage and unrestricted exchange. The amendment allowed states to impose restrictions on access to plant genetic resources as required by national and international obligations, and clarified that "free access" did not imply "free of charge".

In return, Northern governments agreed to the introduction of the concept of Farmers' Rights in the Undertaking. Viewed as a Southern alternative to the intellectual property rights of plant breeders in the North, developing countries and NGOs hoped that Farmers' Rights would restore an element of equity in the global exchange of plant genetic resources. Such rights were defined as:

involve all institutions and individuals that can provide input from the wider social, political, ecological and economic context within which research is carried out. Until now, CGIAR has tapped only a fraction of the knowledge and experience available. More diversity is needed, both in the governance structure of the Group as a whole and in the activities of the research centres.

- **Democracy**

  Any new consultative group must start with the full participation of the South. This is as much an issue of human rights — including Indigenous Peoples' Rights and true Farmers' Rights — as it is of effectiveness. This does not require CGIAR to become a United Nations agency nor to subordinate itself to one, but such options do require fuller discussion. The continuation and strengthening of the informal processes in the present Consultative Group is welcome, but the doors need to opened wider and meaningfully to governments of the South, farmers' organizations and other NGOs.

- **Decentralization**

  The key to successful international agricultural research in the twenty-first century will lie in the capacity of farmers, researchers and research

Plant Genetic Resources and the Struggle for Farmers' Rights

> "rights arising from the past, present and future contributions of farmers in conserving, improving and making available plant genetic resources, particularly those in the International Community, as trustee for present and future generations of farmers, for the purpose of ensuring full benefits to farmers, and supporting the continuation of their contributions, as well as the attainment of the overall purposes of the International Undertaking".

Little progress has been made in realizing these rights. They remain a concept with no legal basis, administrative body or funding. Although the amendment in effect recognized the contribution farmers make to biodiversity, no mechanism has been instituted to reward them for this nor to share equitably its benefits.

Many technical problems need to be resolved as well, for instance, defining what exactly farmers would have rights over — farmers' varieties are heterogeneous and do not remain stable, making identification and protection in terms similar to Plant Breeders' Rights almost impossible. Establishing ownership is also problematic: the innovative process reflects the community setting of the activity, while the result, the plant variety, has a complex parentage as it combines a number of different varieties. Both these factors mean that new definitions of ownership and plant varieties are required.

The issue of Farmers' Rights is repeatedly sidelined at international meetings. For instance, the implementation and funding of Farmers' Rights were scheduled to be part of the 1996 Global Plan of Action for the Conservation and Sustainable Utilization of Genetic Resources. Before the Global Plan could be finalized in Leipzig in June, however, the United States proposed that discussions of Farmers' Rights be postponed until the end of the year.

As a result, the Global Plan makes only brief reference to Farmers' Rights — and even that was contested by the US. A US negotiator at Leipzig, Melinda Kimble, stated "our instructions are to have no mention of Farmers' Rights in the Global Plan of Action".

The separation and delinking of related issues — farmers' rights from conservation of plant genetic resources — has been a major strategy by some Northern countries, the US in particular.

In other forums, meanwhile, farmers' rights have been essentially eliminated. The 1991 revision of the UPOV Convention, for instance, has reduced the right of farmers to save and exchange seeds to an "optional exception"; in practice, this will depend on the will of each national government to follow through this right with legislation. Some countries may permit farmers to save seeds only for use on their own farm, but with payment of a royalty to the breeder.

No Rights, No Action

The imbalances in the global exchange of germplasm, and the need for controls over access and benefit sharing have to be addressed with greater urgency now that GATT requires all signatories to introduce protection for plant varieties through either a patent or *sui generis* system. It is the latter option which has attracted the attention of governments and NGOs as a route for formalizing farmers' rights in legal statutes.

At a meeting held in December 1996 to revise the International Undertaking, GRAIN stressed that "Farmers' Rights should not be negotiated in the absence of farmers" but that "broader participation in the discussions . . . and the whole of the Undertaking" should take place through "a permanent and flexible consultation process at the local, national and international level which involves farmers, their organization and organizations working with them".

Via Campesina, the international alliance of peasant farmers and their supporters, drew up 11 principles on which Farmers' Rights should be based, pointed out that the various consultations should form the basis for implementing country-specific legislation, and concluded that:

> "We cannot postpone definition with the argument that Farmers' Rights are very complicated; these rights are as complicated as man himself, but they have a practical solution."

It is crucial to proceed at the national level by experimenting in implementing Farmers' Rights as they can set useful precedents for international negotiations. As Vandana Shiva said at the time of negotiations for the 1996 Global Plan of Action, "rights have never been given; they have always been taken".

Dwijen Rangnekar

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systems to collaborate at local, regional, sub-regional and national levels. The concept of "centres" should not be sacrosanct. A new Consultative Group must be free to give financial support to initiatives that do not involve centres or where centres do not take the lead responsibility.

Robert Loxston

These principles, if taken seriously, profoundly affect both the organizational set-up and the research agenda of CGIAR. It is unlikely that the majority of NGOs or peoples' organizations would support a new CGIAR that does not accept and incorporate these principles.

Notes and References

1. Quoted in Luz Rimban, "Multinational Firms Dictating RP Farming Processes", *The Philippine Daily Inquirer*, 26 December 1996, p.B-10. The institutional bias against local food crops, which is still deeply entrenched within the world's major agricultural research organizations, has its roots in the agricultural policies of the colonial period. At this time, agricultural research undertaken by European scientists was largely devoted to acquiring, screening, field testing and transporting to plantations all over the world Third World crops that could be grown as commodities — coffee, tea, oilpalm, cacao, rubber and sisal among others. Much of the process took place through the establishment of botanical gardens.
2. The United Nations Environment Programme (UNEP) has recently joined as the fourth co-sponsor.
3. The 16 IARCs are:
   - Centro Internacional de Agricultura Tropical (CIAT) in Cali, Colombia;
   - Center for International Forestry Research (CIFOR) in Bogor, Indonesia;
   - Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT) in Mexico City, Mexico;
   - Centro Internacional de la Papa (CIP) in Lima, Peru;
   - International Center for Agricultural Research in the Dry Areas (ICARDA) in Alappo, Syria;
   - International Center for Living Aquatic Resources Management (ICLARM) in Metro Manila, the Philippines;
   - International Centre for Research in Agroforestry (ICRAF) in Nairobi, Kenya;
   - International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Hyderabad, India;
   - International Food Policy Research Institute (IFPRI) in Washington, DC, USA;
   - International Irrigation Management Institute (IIMI) in Colombo, Sri Lanka;
   - International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria;
   - International Livestock Research Institute (ILRI) in Nairobi, Kenya;
   - International Plant Genetic Resources Institute (IPGRI) in Rome, Italy;
   - International Rice Research Institute (IRRI) in Los Baños, the Philippines;
   - International Service for National Agricultural Research (ISNAR) in The Hague, The Netherlands; and
   - the West Africa Rice Development Association (WARDA) in Bouaké, Côte d'Ivoire.
4. "CGIAR International Centers Week 1996", preliminary end-of-meeting report, CGIAR Secretariat, World Bank, November 1996.
5. For Nelson Rockefeller, the Foundation's President, the first objective of US policy should be "a drive to increase food production in the underdeveloped areas by 25 percent". This drive should be followed by raw material development and extraction, and finally, by increased export of manufactured goods to the Third World from the US and Europe. In short: get poor countries into the market economy, and tremendous export possibilities would open up for the US and other industrial powers.
6. The main "problem" with the local wheat strains was that they grew too tall and fell over when nitrogen fertilizers were applied. When "semi-dwarf" materials were incorporated into the breeding stock, the wheat responded better to fertilizer applications.
7. The IARCs have carried out three main tasks:
   i) collecting seed samples and storing them in gene banks;
   ii) breeding new varieties from the old seeds;
   iii) disseminating technologies and information.

   By and large, the IARCs are "breeding machines" which package their programmes for social and economic change into the genetic structure of new seeds. Improving the productivity of a few major crops is the direct mandate of the "commodity centres", those IARCs which were assigned specific crops to work on. Increasing the human, political and technical infrastructure to national research programmes to support and encourage this work in the mandate of the "issue centre" IARCs which provide support services — ISNAR focuses on national research management; IPGRI on genetic conservation, IFPRI on food policies.
8. Letter to "Mr Leader" of the US Senate from United States Secretary of State Warren Christopher, supported by the Secretary of Agriculture and the Secretary for the Environmental Protection Agency, 16 August 1994.
9. "'Hidden Harvest' Reveals How International Crop Research Aid Generates Large Return to US Consumers and Farmers", *Diversity*, Vol. 12, No. 3, 1996, pp.12-13.
10. RAFI, "Declaring the Benefits", Occasional Paper, Vol. 1, No. 3, Oct. 1994, Tables 1 & 5.
11. Tribe, D., *Feeding and Greening the World*, The Crawford Fund for International Agricultural Research and CAB International, 1994, Chap. 12.
12. The head of the maize gene bank gave this information to Pat Mooney of RAFI during a visit to CIMMYT at the invitation of its Director-General.
13. Tribe, D., op. cit. 11, p.226.
14. Variety names were taken from CGIAR's CD-ROM database by Pat Mooney of RAFI in January 1994 and cross-checked against intellectual property data by René Velvée of GRAIN and Hope Shand of RAFI.

    CGIAR argues that the benefits to the North are matched by its contribution to the South. Forty million hectares of Southern lands are sown to CIMMYT wheat material, for example. This represents 70 per cent of all developing country wheat lands (excluding China). Using CGIAR crop value estimates, CIMMYT contributes at least $3 billion to the South's economy and food requirements. The proportion of the crop sown to CIMMYT stock may have a farmgate value as high as $20 billion.

    The environmental and social costs of such increased production, however, have been huge. In addition to the economic costs of purchasing the agro-chemicals and other inputs needed to obtain the extra yields — CGIAR itself estimates that these amounted to some $20 billion — the industrialization of Southern agriculture has caused immense damage to soils and water resources, and a widespread loss of genetic diversity. These costs have never been estimated by CGIAR.
15. Data obtained by Pat Mooney of RAFI as a member of a CGIAR review of its germplasm collections during 1993-4. Much of the data is published in the review team's report in TAC, *Stripe Study of Genetic Resources in the CGIAR*, Rome, 1994.
16. "Notes on Indian Agriculture", 1952 Rockefeller Report, quoted in Perkins, J., "The Rockefeller Foundation and the Green Revolution, 1941-1956", *Agriculture and Human Values*, Vol. VII, Nos 3 and 4, Summer-Fall 1990, p.11.
17. Anderson, R., Levy, E. and Morrison, B., *Rice Science and Development Politics: Research Strategies and IRRI's Technologies Confront Asian Diversity (1950-1980)*, Oxford University Press, Oxford, 1991, pp.213-214.
18. Anderson, R., et al, op. cit. ??? p.54.
19. *An NGO Review of the International Rice Research Institute in South-East Asia*, SEARice Publications, Manila, forthcoming.
20. For a discussion of chaning CGIAR mission statements, see Ravnborg, H.M., "The CGIAR in Transition: Implications for the Poor, Sustainability and National Research Systems", ODI, Agricultural Administration Network, Network Paper 31, London, 1992, pp.477-48.
21. For example, CGIAR blames erosion in Malawi on population growth. Independent researchers tell a very different story. As Helle Munk Ravnborg points out, "The expansion of large, subsidized plantations, where among other crops tobacco is grown for export, has required much of the more level land and therefore must be considered at least an equal cause of erosion problems." See Ravnborg, H.M., op. cit. 20.
22. TAC, "A Possible Expansion of the CGIAR System", AGR/TAC:IAR/90/24, TAC?FAO, Rome 1990.
23. Ibid.
24. Ibid.
25. TAC dismisses the possibility of major increases in production from traditional systems, arguing that such systems offer a maximum one per cent production increase a year.
26. Chambers, R., *Challenging the Professions*, IT Publications, london, 1993, p.66.
27. Another focus of research is improving the protein content of maize, which in nature has a low content of the essential amino acids lysine and tryptopphan: once achieved, industry will no longer need to compliment maize-based feeds and foods with other protein sources.

Intensifying Agriculture — The Organic Way

by

Kate de Selincourt

Robert Loxston

One of the most frequent justifications given for the need to expand industrial agriculture and introduce genetically engineered crops is that sustainable agriculture is less productive. US Secretary for Agriculture Earl Butz reportedly responded to calls for support for organic farming in the United States by saying, "Show me the first 10,000 Americans who are prepared to starve to death and then I'll do something".

Calculations comparing the two farming systems usually take into account just one yield from a crop, measured in terms of the weight of cereal grains, for instance. In Northern countries, when industrial and sustainable (for example, organic) production systems are compared on this basis alone, the yield from an industrial plot is often higher than that from a sustainable one.

However organic fields which have been under a sustainable, fertility-building agricultural regime for many years — or whose fertility has never been "drawn down" by chemical applications and repeated monocultures — can outperform industrially-farmed ones on the basis of simple tonnage yields alone.

In addition, organic systems are more resilient in maintaining productivity in exceptional conditions such as drought years which lead to disastrous failure in conventional agriculture. For this reason, even experts from the United States Department of Agriculture have recommended that organic agriculture would be the best agricultural practice for the US.

Multiple Yields

But the most productive sustainable agricultural systems which employ intensive labour and knowledge, mixed cropping and integrated farming systems, produce much more than one yield. A wheat field in India which has been heavily sprayed with chemical fertilizers and weedkillers might produce more tonnage of wheat (much of which is exported to feed cattle) than one fertilized with natural manures and weeded by hand. But the latter field also produces better straw for thatching, a significant weight of edible green leafy weeds, rich in vitamin A and protein, which can be consumed directly by the labourers' families. In fact, when recorded yields rise, the true yield is often falling.

Even in the case of marketed products, remarkable gains have been achieved by converting from industrial to organic agriculture, especially in those areas where, unlike in the North, inputs for industrial agriculture are expensive or not fully available (areas of low rainfall without irrigation, for example). In such areas, simple yield improvements of 50 to 100 per cent are not unusual.

In studies covering some two million holdings worldwide, agricultural researcher Jules Pretty reports single tonnage yields for rainfed sorghum and millet production in India rose almost three-fold under "sustainable and people-centred" agriculture; maize yields in Honduras went up two-and-a half times their former levels; while sorghum and millet yields in Senegal tripled. Improvements in yields of irrigated rice have been more modest at 9-12 per cent. But rice paddies not treated with herbicide and insecticide can yield supplementary harvests such as fish, snails and ducks, all of which have high food values.

Increased yields such as these have enabled farmers to diversify into growing other crops for cash, or to reduce the area under cultivation or to leave steeper slopes to revert to perennial vegetation cover. Some systems of sustainable agriculture are so productive that they even enable farmers to compete in the unlevel playing field of the world market.

Industrial agriculture systems are designed to maximize crude tonnage yields per hectare — or in many instances, per labourer, because labour costs in the industrialized countries are so high. In many places, however, labour is more readily available than capital or income to pay for inputs such as chemical fertilizers and pesticides. Intensively-employed labour can produce astoundingly high yields per hectare. For instance, a tiny 400 square metre plot in the Philippines, fertilized with chicken manure only, yielded 2,100 kilogrammes of a combination of 12 crops over a full year. This multiplies up to 50 tonnes per hectare.

Thus, even a report from the 1996 UN Conference on Trade and Development found that "organic production . . . can contribute to higher incomes, better food security and creation of employment", and noted that calculations which favour yields from conventional approaches over organic ones are flawed.

Yields versus Nutrition

Ironically, the exclusive emphasis on ever-increasing weights of cereal yield during the past 30 years of agricultural development means that some people have more to eat but are less well-nourished.

All over the world, but most notably in the Green Revolution lands of South Asia, intakes of iron and other vital nutrients are falling even where calorie intakes are rising. These deficiencies are handicapping children's learning and mental functioning, and are a major factor in maternal mortality. According to a recent *New Scientist* report:

> "the high yield rice, wheat and maize varieties that the Green Revolution spawned are usually low in minerals and vitamins, and because they have displaced the local fruits, vegetables and legumes that traditionally supplied these essentials, the diet of many people in the developing world is now

dangerously low in iron, zinc, vitamin A and other micronutrients."

In Indonesia, a study found that iron deficiency was responsible for poor mental and motor skills in a group of toddlers; Chinese children given zinc supplements improved their score in dexterity and coordination tests compared to those who received no supplements, suggesting that they were malnourished. Vitamin A deficiency, which leads to a generalized susceptibility to infection, is estimated by the World Bank to reduce economic activity in most countries of the South by around five per cent. Iron deficiency causes debilitating tiredness and poor concentration meaning that children cannot benefit fully from their education. Iron is needed to carry oxygen in the blood: under the strain of childbirth, the heart muscle of iron deficient women may be starved of oxygen, and their hearts go into fatal collapse.

Rather than encouraging a return to a more diversified agriculture using more traditional crop varieties, the institutional emphasis has been to breed high-yielding, high-nutrient strains. This project will take "decades", according to CGIAR's International Food Policy Research Institute, which is directing some of the research. During this time, many existing remnants of high-nutrient strains, crops and cultivation techniques may be wiped out for ever.

There is evidence as well that nutrient content is affected not only by the particular strain of plant but also by the way in which it is grown. Chemically grown fruit and vegetables may have less nutrient content weight-for-weight compared to ecologically, or organically, raised crops because artificial nitrate fertilizers encourage them to take up more water. According to the Henry Doubleday Research Association, chemically-grown vegetables may contain as much as 20 per cent more water than organic equivalents. Slower growth and a wider range of nutrients in the soil make for a more rich and complex mix of compounds within the plant.

According to the Consumers' Association, several studies have shown higher levels of calcium, iron, protein, vitamin C and potassium in organic food.

In a 1993 US study, samples of organically-grown apples, pears, potatoes and sweetcorn were found to have up to 30 per cent more — and never less — of a range of minerals, including calcium, magnesium and iron, than did their conventionally grown equivalents.

Clearly, a crop growing in a soil fertilized by a rich mix of organically-derived compounds (manure and compost) will contain a wider range of nutrients than one repeatedly fed with only nitrogen, phosphorus and potassium from artificial fertilizers. Furthermore, organic or traditional farming may enhance the availability of these minerals to the plant roots: the organic matter broken down by micro-organisms has particular physical and chemical properties which hold soluble minerals in the soil rather than allowing them to leach away with rain or irrigation water.

Many factors are known to affect the uptake of minerals from the soil: the presence of a combination of minerals and micro-organisms (bacteria and fungi) in the soil, interacting closely with plant roots, plays a crucial role. As a general rule, however, industrial farming considers just a few of the hundreds of trace elements in the soil and pays little heed to the living organisms which make these minerals available to plants.

Energy Costs

Equally damaging is the industrial food model, which promotes more eating of meat and processed food, and accompanying downstream effects such as increased fossil fuel use and pollution. The downstream energy costs of processing, packaging and transporting food which enters the industrial retailing system have been estimated at about five times those involved in the production of the food itself — and these production costs are almost double those of organic production of the same foods.

In contrast, sustainable agricultural systems lend themselves to a more sustainable "downstream" food economy. The norm of mixed cropping leads to smaller volumes of a wider range of produce which is better suited to local food markets than to long-distance, bulk commodity trade. Fresher whole foods tend to increase the incentives of households to cook for themselves rather than to depend on the more unsustainable and generally nutritionally inferior products of the food processing industry.

Obstacles to Sustainability

Thousands of potentially productive hectares are not being farmed sustainably. In the South, the most productive land is used instead to grow luxury horticulture produce for export, or bulk commodities, many of which find their way into animal feeds. Western Europe consumes the agricultural produce of around five times its own land area, and animal feeds are a high proportion of this.

At the same time, the produce of Northern fields, assisted by state subsidies for machinery, power generation, water, transport and telecommunications, is dumped on the world market, sometimes at prices below that of production. It is difficult for African wheat and beef farmers to go on farming if their national markets are flooded with the same produce at lower-than-cost prices. Just because African farmers are not feeding Africans at present is not evidence that they cannot do so.

When asked why more British farmers did not respond to growing consumer demand for organic produce and convert to organic agriculture, a representative from the National Farmers' Union, a body representing the mainstream of industrial farmers in Britain, replied that "more farmers would like to go organic if they had more fertile soil" — even though the only way to get more fertile soil is by converting to organic agriculture.

The potential contribution of organic and ecological farming to food yields, food security and wider environmental and social "goods" has been recognized time and time again by official bodies over the years — yet policies still fail to support it. Instead, the same arguments are repeated about the need to boost yields by increasing the application of technology. The latest panacea is genetically engineered crops — able, so their proponents insist, to feed the world and save the environment. These claims are no more justified than similar claims made for chemical agriculture in the past.

Sustainable agriculture offers the best means of feeding people — but how many will be starved by industrial agriculture in the meantime?

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From Green to Gene Revolution

The Environmental Risks of Genetically Engineered Crops

Ricarda A. Steinbrecher

Many interest groups claim that an increasing world population cannot be fed unless genetically engineered crops are grown. Such crops, it is argued, will produce higher and better yields than conventional farming methods and have fewer adverse environmental impacts because the frequency, range and toxicity of weed-killer and pesticide applications will be reduced. Ecological risk assessments are said to indicate that several products can be grown safely on a wide-scale. In fact, genetically engineered plants are likely to increase the use of herbicides and pesticides and to accelerate the evolution of "superweeds" and "superbugs". Crucially, major environmental risks associated with genetically engineered plants are the unintended transfer to plant relatives of the "transgenes" and the unpredictable effects. Risk assessments are limited and have primarily been based on an outdated understanding of gene behaviour.

The major application of genetic engineering in agriculture is food crops. Genes believed to determine specific traits — height, tolerance to frost or drought, and protein or fatty acid composition, for example — are spliced into plants from unrelated organisms, such as animals, other plants, fungi or bacteria, in the belief that the genetically engineered plant will exhibit the desired trait.[1] For instance, antifreeze protein genes from winter flounder were added to tomatoes to create a fruit that could withstand colder temperatures. Genetic material from chickens and silk moths have been spliced into potatoes to confer resistance to bacterial diseases. Engineered versions of most of the world's major food, fibre and fruit crops have now been produced, including corn, wheat, rice, potato, soyabean, sunflower, oilseed rape, potato, cotton and tomato.

In the past decade, these genetically engineered organisms have begun to leave the laboratory and enter the wider environment. Hundreds of field tests of genetically engineered crops have been taking place since 1987, mainly in the United States and Britain.

In plant field release trials carried out between 1993-1994 in the 14 OECD countries, herbicide tolerance was the most common genetically engineered trait being tested (36 per cent); insect resistance was a close second at 32 per cent, while tests for virus resistance and quality traits (altered fruit ripening, for example, or increased solid content in fruits and tubers) accounted for 14 per cent each, leaving four per cent to "others" (including disease resistance and male sterility in plants).[2]

Chemical corporations head the list of those applying to field test genetically engineered crops. Between 1987 and 1993, they constituted 46 per cent of applicants in the United States;[3] more than half these chemical company applications came from Monsanto,[4] whose patent on the glyphosate-based weed-killer, Roundup, one of the best-selling herbicides worldwide, runs out in the year 2000.[5] Seed companies, universities, government departments, food companies and small biotechnology companies account for the rest.[6]

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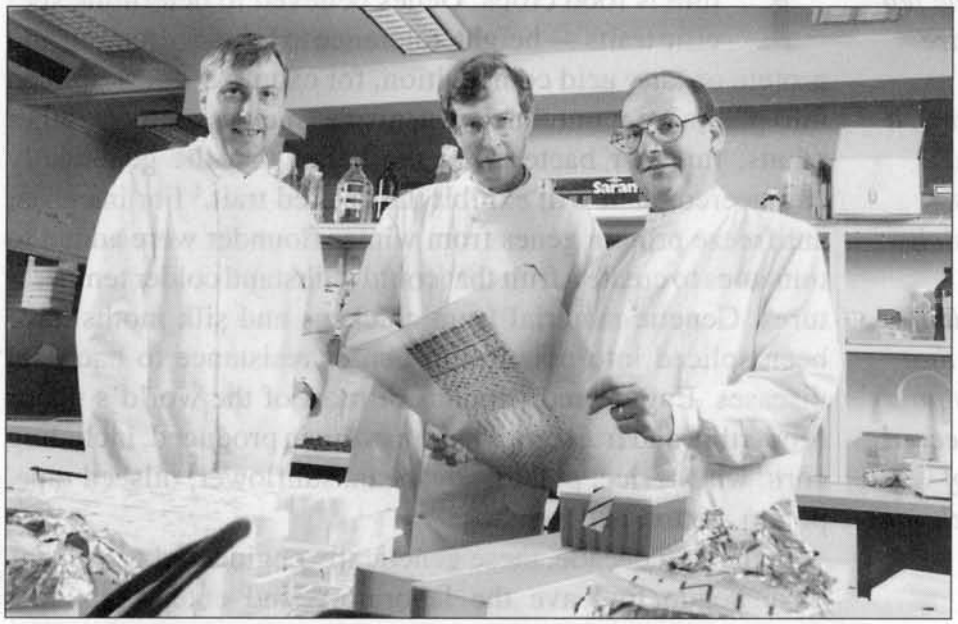
Following field tests, several transgenic crops have received government approval to be sold to the public. In 1994, a tomato engineered by the Californian biotechnology company, Calgene, for delayed ripening was the first genetically engineered wholefood to receive such approval in the United States. Later that year, Upjohn's subsidiary Asgrow Seed Company gained approval for a squash engineered to be resistant to a certain virus.[7] Next came potatoes engineered to produce an insecticide, and canola (rapeseed) altered to produce lauric acid, a key ingredient in soap, detergent, lubricants and cosmetics.[8]

Some of these crops are now being grown on a commercial scale across thousands of acres in the United States — in particular, Monsanto's herbicide-tolerant soyabean[9] and pesticide-resistant cotton; Ciba-Geigy's herbicide-tolerant and pesticide-resistant corn (which also contains a gene for resistance to antibiotics); and Calgene's high-lauric oilseed rape.



Jean Garon PR

Scientists at Axis Genetics, one of the British firms that has applied for authorization to release genetically engineered organisms into the environment in field trials. The company has also been researching the manufacture of vaccines from plants.

Herbicide Tolerance and Superweeds

Making plants tolerant to specific chemical herbicides is the most common genetically engineered trait currently being developed and tested; in the UK, plants on trial include oilseed rape, sugar beet, swede, maize, chicory, winter wheat and spring wheat.[10] Monsanto's creation of Roundup-tolerant crops includes soyabeans, cotton, oilseed rape and corn. The theory is that fields growing the engineered crop can be sprayed with the specific herbicide at any stage in the growing season to kill off weeds without killing the crop plants. Chemical companies which sell weed-killers are the driving force behind this research.

"Weeds" are any plants that happen to be in the wrong place at the wrong time. No plant is intrinsically a weed — the designation depends on context and human values. The same plant may be a weed in one situation and a desirable crop in another.[11] Persistence or invasiveness are the two main ways that plants become weeds — by persisting in a place where they have been introduced, or by invading and altering other habitats. Weeds can take away nutrients, water and light from food crops. In 1991, the widespread use of herbicides to remove weeds from farms, lawns and roadsides in the US cost an estimated $4 billion.[12] Further economic costs are incurred when weeds and their seeds are harvested along with a crop, reducing the quality of the crop seed.

If a plant is repeatedly exposed to a specific weed-killer, however, it can develop tolerance to the herbicide, an evolutionary response more likely to occur in some plants than in others. An Australian farmer in northern Victoria, for instance, recently discovered that ryegrass, the most common weed in Australia, on one of his fields was no longer affected by Monsanto's herbicide, Roundup, after just 10 sprayings over 15 years. Researchers at Charles Sturt University in New South Wales showed that the ryegrass could tolerate nearly five times the recommended spraying dose.[13]

If spraying occurs regularly, there is every reason to believe that weeds in or near fields of genetically engineered crops would develop resistance to the herbicide the crop is tolerant of. As weeds became resistant, higher and higher doses of herbicide would need to be used, leaving larger and larger amounts of chemical residue on the crops. Monsanto has applied to the regulatory authorities in several countries to increase the residue limit of Roundup in crops from six milligrams per kilogramme dry weight to 20 milligrams.[14] After a certain time, a new genetically engineered plant would have to be grown, resistant to a different kind of herbicide.

In addition, the engineered crop may itself become a weed. Before growing certain crops, it is standard practice to "clean" the field thoroughly with an all-purpose herbicide to kill off not only ordinary weeds but also "volunteers" — individual crop plants left in the field from a previous harvest or grown anew from its uncollected or spilled seeds. Volunteers tend to compete with and contaminate subsequent crops. Monsanto's glyphosate-based Roundup or Ciba-Geigy's glufosinate ammonium-based Basta are standardly used for such field clearing.

The widespread use of crops genetically engineered to be tolerant of these herbicides, however, would demand either the application of other herbicides between sowings of different crops or more costly methods such as the mechanical clearing of weeds.

The effects of chemical herbicides are well-documented. They reduce soil fertility, pollute water, deplete earthworms and beneficial microbes, and have varying short- and long-term affects on human health.[15] While Monsanto has claimed that its glyphosate weed-killer is "environmentally friendly", "biodegradable" and "practically non-toxic" to mammals, birds and fish,[16] there is mounting evidence that glyphosate-based herbicides can be lethal to beneficial insects such as ladybirds and lace wing flies which are predators of common agricultural pests such aphids.

Swifter Pest Killers

The second most popular application of genetic engineering in crops is the development of insecticide sprays using genetically engineered organisms and the creation of plants which generate their own insecticide against pests.[17]

Insects are usually very specific about what they eat; they have evolved highly-specialized diets which do not compete with the feeding and breeding grounds of too many other insect species. Acres and acres of monoculture crops present specific insects with an ideal environment in which to flourish. Agribusiness interests describe warlike scenes in which armies of herbivores attack and destroy wide swathes of defenceless plants — unless they are vanquished with applications of chemical pesticides. (Like herbicides, occasional use of a pesticide can control pests; constant or repeated use, especially of the same chemical control agent, provokes insect populations to build up resistance to the chemical, even if it is a powerful compound such as DDT[18] or Cyclodiene.[19])

The interaction between plants and insects, however, is more a process of co-evolution than of extermination. Over time, plants have developed their own "defences" to insects such as hairiness, thorniness or the production of substances which are toxic to the pests. Plants produce an estimated 10,000 pesticidal endotoxins and other natural chemical defence substances.[20]

One branch of genetic engineering aims to harness endotoxins produced by other organisms, such as arthropods and bacteria, to fight the "insect wars". Some biotechnologists are "improving" a range of naturally-occurring insect viruses with genes for insecticidal toxins taken from other species such as scorpions and mites. Strong attention has been given to the group of baculoviruses.[21] As these viruses enter the insect via contaminated food, suspensions containing the virus can be sprayed onto insect-infected crops to get rid of the pest. Naturally-occurring insect viruses, however, take their time about replicating and releasing new virus particles which eventually kill an insect; genetically engineered viruses act more rapidly. As Oxford scientist David Bishop, who equipped a baculovirus with a scorpion gene and tested it in a field release, summarized, "The aim of genetic engineering is to increase their speed of kill".[22]

The baculovirus field releases were heavily criticized by the public as well as by other scientists. Charles Godfray of Imperial College, London, for instance, criticized the "choice of a non-British virus for the experiments; the host range of the virus; the consequences and risks of an escape of a manipulated virus into the environment; and the possibility that, if escape occurrs, the introduced genes may move into other viruses through recombination".[23]

Pest Resistance and Superbugs

Genetic engineering has expanded strongly in the area of creating plants which generate their own insecticide. One way of achieving this has been to splice into a plant a gene derived from the naturally-occurring soil bacterium, *Bacillus thuringiensis*. This bacterium produces a crystal protein, Bt protoxin; when the toxin is consumed by insects and larvae, it is activated by acid stomach fluids and destroys the digestive tract. Some organic farmers use suspensions containing this bacterium as a biopesticide.

Unlike the naturally-occurring bacterial protoxin, however, the transgene has been altered to be active as soon as it is produced by the plant — it does not need to be activated by insects' highly-acidic stomach fluids — and thus harms and kills a much wider range and number of insects and soil organisms, including those which help build up soil fertility.

Crops genetically engineered with Bt toxin are now being grown in the United States. Ciba-Geigy has "Maximizer Corn", while two US companies, Mycogen Corporation in San Diego and Northrup King in Minneapolis, and French company Pioneer Genetique SARL have their own Bt corn products. Monsanto has a Bt tomato, Bt potato and Bt cotton, Rohm & Haas a Bt tobacco and the University of California-Davis a Bt walnut.

When is a Gene not a Gene?

A gene is a unit of hereditary information: it is believed to instruct a cell to make specific proteins such as insulin, blood clotting factors and some hormones. Every cell of every organism — be it a salmon, beetle, tree or human being — has a full set of instructions on how to "build" the cell and how to function as part of the whole organism. All this information, that is, all an organism's genes, is stored on a long molecule of DNA (deoxyribonucleic acid) in the form of the well-known double helix.

Traditional genetic understanding holds that a gene — a section of DNA — is a distinct and independent unit which can be isolated from the DNA molecule, characterized as to its function and moved to the DNA molecules of other organisms while still carrying out its function.

By-passing evolution, the technique of genetic engineering transfers genetic material (hereditary information) from one species to an unrelated one with which it would not usually interbreed; it transfers, for instance, genetic material from an insect to a plant, or from a pig to a fish, or from a human-being to bacteria. In theory, the receiving species will exhibit the characteristic of an entirely different species which the transgene encodes.

This understanding of genes has been drastically altered by recent findings which indicate that, far from remaining constant, a gene may behave differently according to its environment, its location on the chromosome and the presence of other genes. A gene for one characteristic in one species can give rise to a different characteristic in another species. The transfer can yield completely unpredictable and unstable characteristics.

Soil microbiologist Gunter Stotzky has shown that the genetically engineered Bt toxin can survive in soil and keep its toxicity for up to nine months compared to the naturally-occurring toxin which degrades at least two to three times faster.[24] Because the plants produce the pesticide continuously, insects are exposed to it all the time. All these conditions create strong selection pressure on insects to develop resistance to the toxin, an evolutionary response which would nullify the intended effects of the transgene.

Sara Cross, Gold Hill Organic Farm, Child Okeford, Dorset

Rather than growing vast swathes of just the one crop which insects can devastate, planting several crops together in a field can reduce the amount of food for pests, for instance, growing (from left to right) spinach, broad beans, fennel in the same row as parsnips, leeks and courgettes. As the roots of these plants extend down to differing depths, and some of them take out nitrogen while others fix it in the soil, such mixtures can improve soil fertility as well. Companion planting can also prevent infestations; the smell of onions planted next to cabbage, for instance, keeps cabbage pests at bay, while marigolds planted near carrots help ward off carrot root fly.

Resistance to *Bacillus thuringiensis* biopesticides was observed more than ten years ago in a lepidopteran insect, *Plodia interpunctella*, a pest to grain and grain products,[25] and has also been found in the diamondback moth, *Plutella xylostella*, a pest of cruciferous crops (those with four equal petals arranged crosswise).[26] When moth larvae were fed on cabbage leaves treated with *Bacillus thuringiensis* in an experiment, selection pressure led to an initial build-up of resistance 1,000 times greater than the level in larvae which had not eaten the treated cabbage. Even 15 generations later, none of which had consumed the Bt toxin, the resistance level was still around 170 times the level of the control populations.

If insects developed resistance to the engineered Bt toxin, conventional farmers would have to go back to chemical insecticides, while organic farmers would have lost one of their most valuable pest-control agents. In addition, "superbugs" could emerge — insects which have adapted their behaviour and genetics in unpredictable ways to survive in the constant presence of toxins. This could include developing resistance to a much wider range of insecticides than the one they were originally exposed to and feeding on plants they would not usually have touched.[27]

There are likely to be other outcomes as well, as Monsanto has already found to its cost. The company's genetically engineered cotton, NuCOTN®, was grown commercially for the first time in 1996 across vast regions of the southern United States. The altered Bt toxin was supposed to protect the crop from the cotton bollworm (*Helicoverpa zea*) and from the tobacco budworm (*Heliothis virescens*). An unusually hot and dry summer, however, meant that neither plants nor pests behaved according to plan. Plants that become stressed under heat and drought, as cotton does, commonly alter their protein synthesis. (Altered plant behaviour as a result of stress is not taken into account in risk assessments of releasing genetically engineered plants.) The cotton seems to have altered its Bt production as well, yielding lower levels of the toxin than in "normal" climatic conditions. The cotton bollworm, meanwhile, thrives in hot and dry conditions. The combination of lower Bt levels and vigorous worms caused damage to nearly half the two million acres planted to NuCOTN®. Monsanto ordered the affected fields to be sprayed with traditional chemical pesticides to save the crop.

At the time of the infestations, Professor Fred Gould of North Carolina State University pointed out that there would probably have been pest problems anyway, even without the heatwave. In field tests, the genetically engineered cotton did not kill all the bollworms, just 80 per cent of them. Gould pointed out that "80 per cent mortality is exactly what researchers use when they want to breed resistant insects".[28] Thus growing Bt cotton provides the perfect breeding ground for Bt-resistant bollworms.

To slow down (but not prevent) the build-up of resistance to Bt toxin, one strategy is to plant "refugia" — areas close to the Bt crop, sown with the same crop type, cotton for instance, but Bt-free. Insects are drawn to feed on these areas rather than the Bt crop, and will therefore be under less pressure to adapt to the Bt toxin. Monsanto suggests that refugia of Bt-free cotton should constitute four per cent of the total area sown, in an effective acknowledgement that Bt crops generate Bt resistance. Professor Gould claims that this percentage would slow the build-up of resistance if Bt cotton led to 100 per cent mortality in cotton bollworms. As it causes 80 per cent mortality, however, 20 per cent of the crop area would be needed.[29]

Because they generate resistance, the time span in which these engineered crops will be effective is limited, a fact explicitly acknowledged by some scientists. In the context of corn engineered with Bt as a defence against the corn earworm (in fact, the same insect as the cotton bollworm, *Helicoverpa zea*), writer Russ Hoyle commented in *Nature Biotechnology:*

The Risks of Risk Assessment

Supporters of genetic engineering in agriculture claim that the engineered crops now on the market have been extensively tested in the laboratory and in field trials, a process which has indicated that the ecological risks are minimal or non-existent.

In the laboratory, "microcosm studies" were carried out of genetically engineered organisms "released" into contained, miniaturized ecosystems. These experiments, it is claimed, reflect the organisms' behaviour in the wider environment. While these tests may indeed reveal some of the more exaggerated ecological distortions that could occur, they are usually too simplified and short-term (a matter of weeks at most) to reveal the longer-term hazards of persistence, genetic transfer and ecological disruption.

"Monitored release" field trials, for instance, certainly enable the behaviour of genetically engineered organisms to be observed under less artificial conditions, but reveal little about the risks entailed in growing a crop on a commercial scale. Several reasons account for this:

- The lack of genetic transfer in field tests is more an indication that the escape of plants or genes from the test plots has been severely curtailed than proof that it did not and cannot occur;
- Test sites tend to be far removed from other crops and wild relatives, whereas commercial fields are unlikely to be;
- The number of plants grown on a commercial scale across millions of acres is much greater than the number involved in field trials of just ten acres in size at maximum. The probability of gene transfer in commercial growing is thus magnifed several times over;
- The ecological conditions at the release site may not be the same as those at commercial sites. Crops will be grown commercially in far more diverse environments and climates than those prevailing during the field trial. They will thus encounter unfamiliar ecosystems, insects and soil microorganisms and be subject to a greater variety of weather events such as floods and storms.

Industry and government bodies argue on a case by case basis that, if a trial has not revealed any scientific evidence that the particular genetically engineered plant is a danger to the environment or a risk to human or animal health, then it is safe to be grown on a wide scale. No evidence of harm, however, is not proof of safety.

In granting approval for market, no assessment is required of the cumulative effects of growing or consuming genetically engineered crops. There is no requirement to monitor the commercial site for transgenic escapees.

Even as a legal obligation, however, such monitoring would amount to little unless the results were acted upon — for instance, by withdrawing seeds from the market if undesirable impacts were detected. Escaped transgenes, meanwhile, could not be withdrawn from the wider environment.

In addition, monitoring the impacts of humans consuming genetically engineered food, which is not being carried out at present, will be virtually impossible as long as such genetically engineered food is not separated from other foods and is not labelled.

An additional consideration of the safety of genetically engineered crops is that safety in one country does not automatically translate into safety in another. For instance, gene transfer from genetically engineered corn and soyabean to other plants is unlikely to occur in the United States because these crops do not have any wild or weed relatives in the country. This does not mean that it will not occur in other countries where the plants do have relatives, in particular those countries from where the crop originated.

"Scientists inside and outside the of the biotechnology industry know that, in time, the product will create a tougher, resistant cornborer. But they don't know when or how to exactly avoid it. With assiduous crop management techniques, some believe the window for such Bt products is less than a decade."[30]

Disease Resistance

Alongside the development of herbicide tolerance and pest resistance, some scientists are seeking to engineer plants to be resistant to pathogens such as fungi, bacteria and viruses. This third arm of the genetic engineering of plants could create severe diseases resulting in substantial crop losses. In the case of fungi or bacteria, goals are far from being realized, but research in creating plant resistance or tolerance to viruses is progressing more quickly.

To infect a plant, viruses are dependent on a vector, such as an insect, worm or fungus, or on lesions on the plant. The conventional method of preventing insect-mediated viral infection is to apply large amounts of insecticides to kill the vector.

The most effective way of engineering plant resistance to viruses has been to insert genes containing sections of the viral genome into the plant which then produces "coat-protein-mediated" resistance.[31] Field trials have taken place on several major crop plants: tomato (against tomato and tobacco mosaic viruses), potato (against potato x, potato y and leaf-roll viruses), squash and cantaloupe (against cucumber mosaic and papaya ring spot viruses) and cucumber (also against cucumber mosaic virus).[32]

Evidence and concern are accumulating, however, that genetic engineering of viral resistance in plants could lead to the development of new viruses, which could give rise to potentially more serious diseases.[33] It has been reported, for instance, that naturally-occurring viruses can recombine with the virus fragments inserted into plants, especially if they are under strong selective pressure.[34] Research has also indicated that recombinations between the fragment and the infecting virus could yield different variations in the newly-combined virus.[35]

"Transgenes transferred into the wider environment cannot be tracked down and simply recalled to the laboratory. A ripple effect on other species will take place, even if it cannot be predicted when such an effect will occur, to what extent, or in which species"

Gene Transfer

The ecological risks of increased herbicide tolerance, pesticide resistance and viral resistance are increased many times over if the transgene spreads from the crop to related plants.

Genes do not necessarily stay put. It is widely known that cross-pollination can occur between crop plants and their wild or weed relatives.[36] Proponents of transgenic crops, however, argue that cross pollination with genetically engineered organisms is rare because related plants are not usually in close enough proximity to crop fields. If any hybrids evolved between genetically engineered plants and their relatives, they claim that these hybrids would tend to be sterile (and, like mules, produce no subsequent generations) or carry disadvantages such as lower fertility or disease sensitivity such that the transgene would not manifest itself in the wild population.

However, in field tests with genetically engineered potatoes (*Solanum tuberosum*), gene transfer readily occurred over a long distance. Ordinary potatoes of one variety were grown in patches at varying distances from potatoes of a different variety engineered with a gene for antibiotic resistance. Seeds collected from the ordinary potatoes indicated that 72 per cent of the plants grown close to the transgenic ones contained the resistance gene while of those grown up to 1,100 metres away, 35 per cent had the transgene.[37]

The risk of transgenic crop spread has also been studied for engineered oilseed rape (*Brassica napus*) and its weedy relative (*Brassica campestris*). Thomas Mikkelsen and his colleagues at the Riso National Laboratory in Denmark established that the transgene for herbicide resistance inserted in the crop spread to weeds easily, producing fertile, transgenic, weed-like plants after just two generations of hybridization and backcrossing.[38]

Gene transfer has also been shown between cultivated radishes (*Raphanus sativus*) with a distinct genetic marker and their weed relatives.[39] The resulting hybrid weeds produced more fruit and seed than the original weed. Thus, any gene — for instance, one for herbicide tolerance — which was transferred from the crop radishes to the weed would persist in such a hybrid plant and could, over time, increase in frequency in the gene pool.

Thus, the spread of engineered traits, particularly those that confer survival advantages to plants such as herbicide tolerance and pest resistance, is a matter of time rather than of infinitesimal coincidence. Even traits which confer disadvantages as far as the plant is concerned, delayed or disabled ripening for example, will still enter the gene pool of crop relatives. As researcher Paul Hatchwell concluded, "in sensitive ecosystems, particularly where certain species are already threatened, large numbers of new introductions could make the difference between extinction and survival".[40]

The sheer numbers of genetically engineered organisms released into the environment in field trials and commercial growing will ensure that at least some of them persist, spread out of control and affect ecosystems. These releases could well be taking place at a rate far quicker than that at which ecosystems can comfortably absorb such organisms. Compounding the problem is that gene combinations from dramatically different organisms have no known evolutionary precedent.

When it becomes evident that an engineered gene has delayed, or previously unnoticed, side-effects or leads to unwanted and unpredicted plant behaviour, farmers could (in theory) stop growing the engineered crop so that no more direct gene transfer occurred. Such effects could include the triggering of allergies, or the weakening of a plant's defences, resulting in increased crop infections caused by pathogens. There is no way, however, to track down and recall to the laboratory all those transgenes already transferred into the wider environment. A ripple effect on other species — insects, soil organisms, birds, fish and mammals — will take place, even though it cannot be predicted when it will occur, to what extent or in which species.

Unpredictability

The uncertainty and impossibility of predicting exactly what will happen as a result of intended — and unintended — gene transfer is a key feature of genetic engineering.

When the technology was in its relative infancy a decade ago, a gene was regarded as a distinct unit of inheritance, responsible for the production of a specific protein and acting independently of other units and its surroundings. If a gene carries the instruction to produce a red pigment, for instance, it was thought that it would do nothing else besides this, irrespective of its location on a chromosome or its neighbouring genes.

Recent findings, however, illustrate a distinct lack of knowledge and understanding of how genes work and how they are regulated — which means an almost total inability to predict what will happen when a gene is taken out of one organism and randomly inserted into another. Despite its name, genetic engineering cannot command a gene to insert itself in a particular place on a chromosome, nor predict where the gene will do so. Thus the transgene can end up in any neighbourhood of genes and can even insert itself into another gene.

This problem was unexpectedly illustrated in field trials in Germany in the early 1990s with 20,000 genetically engineered petunia flowers (*Petunia hybrida*).[41] A gene for the colour red from maize and a gene for resistance to antibiotics generated by a bacterium were spliced into the petunia. The theory was that the engineered petunia would exhibit those characteristics in addition to its own, but would otherwise be the same. When planted out, however, the genetically engineered petunia had more leaves and shoots, a higher resistance to pathogens (especially fungi), and lowered fertility. All these characteristics were completely unrelated to the colour gene or antibiotic resistant gene and were different from the non-engineered plant. These unrelated multiple side effects ("pleiotropy") of introduced genes cannot be predicted in advance and are not always visible or easily detected.

In another experiment, a gene thought to be responsible for pigmentation was extracted from the petunia and altered so that it was constantly "switched on", that is, continuously producing the relevant "colour molecule". It was then spliced back into other petunia plants which had their own unaltered gene. Researchers expected the resulting petunia flowers to be a darker shade of red than usual. In a large field trial with 30,000 plants, however, up to 50 per cent of the plants showed unexpected "unregularities" in colouring, including completely white flowers.[42] It appeared that the genes for colouring had been switched off or "silenced".

This newly-discovered phenomenon of "gene silencing" is due to the presence of multiple copies of the same gene. The addition of just one copy of a homologous gene can switch off all homologous genes rather than enhance them. Gene silencing is believed to have played a "substantial part in the evolution of genes, genomes and mechanisms controlling gene expression".[43] In addition, little is known about environmental factors which can switch gene sequences on or off.

Introducing novel genes into plants can also result in newly-introduced copies of genes disappearing altogether or, conversely, multiplying in great numbers. In an experiment with rice (*Orya sativa*) which had been genetically engineered with a gene that conferred resistance to antibiotics, scientists discovered that each offspring either had more or less copies of the gene than the parent in what seemed to be a random pattern.[44]

While some scientists are eagerly trying to unravel the secrets of gene regulation and others studying the build-up of resistance levels in plants and insects, industry is already applying the limited and incomplete knowledge gained so far on a wide scale for commercial purposes — no matter what risks the infant technology might pose to the environment.

M Nimmo

Two elm trees, one dead and the other dying of Dutch Elm Disease. The fungus, Ceratocystis ulmi, *which causes the disease seems to have arrived in Britain in Southampton in the mid-1960s from a Canadian timber shipment. The disease spread rapidly, leaving most of the country's elm trees dead within two decades.*

*The adverse effects caused by the intentional or accidental release of exotic organisms in the past into an environment can indicate some of the potential risks of releasing genetically engineered organisms. While some exotic plants can find a niche in an unfamiliar environment with little ecological disruption to it, others have been able to compete effectively with other plants and reach weed status. For instance, many freshwater habitats and canals in Africa, South-East Asia and the United States are now choked by the water hyacinth (*Eichhornia crassipes*) from South America. One study of historical introductions into Britain of exotic species suggested that ten per cent of them became established in the wild, and that ten per cent of these became pests. Of the weeds present in Australia, 60 per cent are introduced, as are 80 per cent in New Zealand. Introduced insect species — largely the result of European settlement — represent the highest proportion of pests in North America (over 60 per cent), Australia, New Zealand and South Africa.*

The release of potentially-disruptive genetically engineered organisms at rates far higher than those at which they can be accommodated by ecosystems poses considerable ecological risks.

(Not) Feeding the World

Several groups claim that genetic engineering in agriculture is necessary to feed a growing world population, particularly those in the South, without impacting unduly upon the environment.

The fact that transgenic crops are primarily being developed by corporations whose goal is to make profit and whose target customers are people who can pay — almost all the transgenic crops on the market will be consumed in the North — casts doubts upon these claims.

They are undermined still further by the priorities of those carrying out the research. A report by the Biotechnology Industry Organization suggests that much effort will be devoted in future to applications beneficial to the transport and processing of food. Delayed ripening or rotting of fruit and vegetables, for instance, will improve the appearance of produce, allowing it to be transported over longer distances and kept on supermarket shelves for longer.

The executive vice president of business development at DNA Plant Technology, California, David Evans, stresses the importance of preventing "post harvest losses" due to ripening and rotting:

> "Because many tropical fruits are shipped to the US as unripe fruit only, their expense and poor taste never allow them to reach their economic potential. Papayas, novel bananas, pineapples and mangoes are all examples of this problem. Genetic engineering of these fruits should open exciting new markets for these crops, grown in developing countries. For example, Charentais melons — a delicious fruit rarely found in the US — could certainly have a major market impact if delivered with quality and flavour experienced locally."

He continues:

> "anything that improves the taste, availability and variety of produce for the US consumer should have an overall positive impact on the citizens of the world's health and wealth".

Comments such as these have led Jane Rissler and Margaret Mellon from the US Union of Concerned Scientists to conclude that:

> "if current trends continue, the output of biotechnology will resemble that of traditional breeding. It will be aimed primarily at growers, processors and transporters, with a smaller set of premium products aimed at consumer niche markets . . . Biotechnology fits comfortably into modern food systems that emphasize food processing, consumer niche markets and production efficiency."

Thus high-technology crops will not serve as a technological fix for hunger. As Rissler and Mellon point out, "they will not compensate for decades of environmental abuse, misguided agricultural policies and income disparities".

Andre Maslennikov/Still Pictures

Which of the tomatoes in the top right hand corner of the picture is genetically engineered? In most countries, labelling that a particular food is genetically engineered is voluntary rather than mandatory. Genetically engineered produce is, in most cases, indistinguishable in appearance from non-engineered types, a fact used by the technology's proponents to assert that there is no difference between the two. These issues are of particular concern when considering the proposed engineering of fruits to contain antibiotics or aspirin — a doctor's prescription of "an apple a day" takes on a new rationale.

Sources: Evans, D., "Produce-on-demand: What's good for US markets is good for world markets too", *Nature Biotechnology* 14, 1996, p.802; Rissler, J. and Mellon, M., *The Ecological Risks of Engineered Crops*, MIT Press, Cambridge, MA & London, 1996.

From Green to Gene

The claims made for the gene revolution echo those of the Green Revolution — increased food production from new, higher-yielding seed varieties with world hunger becoming a thing of the past, the only difference being that this time the seed varieties are newly-created rather than newly-bred.

The effects of three decades of Green Revolution agriculture have been clear for some time: pesticide and herbicide poisoning of people, animals, soil and water; soil erosion and land degradation; loss of biodiversity; profits for the few, bankruptcy and landlessness for many; replacement of local economies and farming techniques with an export crop economy. All these impacts will not be lessened with the gene revolution in agriculture, but increased and expanded.

By using genetic engineering, corporate scientists are attempting to transform nature to their own blueprint. In the attempt, the technology will almost certainly backfire on the environment in a myriad of ways. For farmers and peasants, meanwhile, it presages further enclosure, a process which started with the privatization of land as property and continued with the Green Revolution and the patenting of seeds. Now genetic engineering is attempting to enclose the very basis of life.

Notes and References

1. In the early 1980s, proponents of plant genetic engineering predicted that it would easily produce miracle crops that would resist drought, fix their own nitrogen from the air and resist disease. They envisaged corn thriving without added nitrogen fertilizer; cotton plants withstanding insects without added insecticides; drought-tolerant crops reclaiming environmentally-degraded land — and a high return on their investments. The technology has now proved to be more difficult, taken longer and cost more. Genetic engineers discovered that they were limited in the number of genes that could be transferred to between two and five without something going awry and in the kinds of traits that could be engineered with the genes that had been isolated. In particular, the most desirable traits, such as increased yields, drought resistance and nitrogen fixation, were discovered to be determined by many genes. Nitrogen fixation, for instance, is now believed to require a complex interplay of dozens of plant and bacterial genes, while the complement of genes that determine yield and drought-resistance are not fully understood. The biotechnology industry has thus had to scale back its expectations for the genetic engineering of plants. See Rissler, J. and Mellon, M., *The Ecological Risks of Engineered Crops*. MIT Press, Cambridge, MA, 1996, p.14.
2. *New Scientist*, 7 January 1995, p.23. Over 1986-1992 in the 14 industrialized OECD countries, the proportions were: herbicide tolerance (57 per cent); virus resistance (13 per cent); insect resistance (10 per cent); quality traits (8 per cent); and "others" (12 per cent). See Organization for Economic Cooperation and Development, *Evaluation of Biosafety Information Gathered During Field Releases of GMOs*, DSTI/STP/BS (92)6.
3. Other chemical companies include Upjohn (Asgrow Seed), DuPont, Sandoz (through its subsidiaries Northrup King and Rogers NK Seed), Ciba-Geigy, Hoechst-Roussel, ICI and American Cyanamid. See Rissler, J. and Mellon, M., op. cit. 1., p.13.
4. Ibid. Monsanto produced DDT and Agent Orange.
5. It is likely to be replaced by Roundup-Ultra.
6. US universities and government institutions include USDA Agricultural Research Service, Cornell University, North Carolina State University, University of Kentucky, University of California, Michigan State University; seed companies include Pioneer Hi-Bred (which accounts for over half the seed company applications), DeKalb Plant Genetics, Holden's Foundation Seed, Petoseed and Harris Moran; biotechnology companies include Calgene (which accounts for 82 per cent of the independent company applications), DNA Plant Technology and Agrigenetics; and food companies include Campbell Soup, Heinz and Cargill. See Rissler, J. and Mellon, M., op. cit. 1., p.13. Applicants in the UK for the years 1995 and 1996 to release genetically engineered organisms to the environment included Advanced Tech Cambridge, AgrEvo UK Crop Protection, Axis Genetics, Monsanto, Nickerson BIOCHEM, Plant Breeding International, Plant Genetics Systems NV, Scottish Agricultural College, Scottish Crop Research Institute, Sharpes International Seeds, University of Derby and Zeneca.
7. Ibid., p.11. Asgrow Seed Company has since been sold to the Mexican company, Empresas La Moderna.
8. Ibid., p.4. Traditional sources of lauric acid are coconut and palm kernel oils, grown in tropical countries.
9. *See* McNally, R. and Wheale, P., "Biopatenting and Biodiversity", *The Ecologist*, Vol. 26, No. 5, p.227; Sheppard, J., *Spilling the Genes: What We Should Know About Genetically Engineered Foods*, Genetics Forum, London, October 1996.
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11. See Rissler, J. and Mellon, M., op. cit. 1.
12. Aspelin., et al., "Pesticides industry sales and usage: 1990 and 1991 market estimates," Environmental Protection Agency, Office of Pesticide Program, Economic Analysis Branch, Washington, DC, 1992.
13. *The Australian*, 20 June, 1996; *The Sunday Herald Sun*, 23 June, 1996; *The Canberra Times*, 19 June, 1996. Ryegrass has also been found to have developed resistance to other herbicides.
14. The US and EU have agreed to the higher limit; Australia has still to reach a decision.
15. See, for example, Briggs, S.A./Rachel Carson Council, *Basic Guide to Pesticides: Their Characteristics and Hazards*, Taylor & Francis, London and Washington DC, 1992.
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    A customer information leaflet from supermarket chain Sainsbury entitled "Genetically Modified Commodity Crops" states that "Certain varieties of maize, grown in the USA, have been genetically modified to be resistant to a pest, the European Corn Borer. This pest destroys, on average, four per cent of the world's annual crop and up to 20 per cent in severely infested regions." The implication is that a four per cent loss of maize is unacceptable and that there will be no loss of genetically engineered Bt corn. The leaflet does not mention the refugia, which should be up to 20 per cent of the growing area to slow down the build-up of resistance. No one has yet calculated — or at least not made public — the probable short- and long-term losses of Bt corn.
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Too Many for What?

The Social Generation of Food "Scarcity" and "Overpopulation"

Nicholas Hildyard

Discussions of population and food supply which leave out power relations between different groups of people will always mask the true nature of food scarcity — who gets to eat and who doesn't — and lead to "solutions" that are simplistic, frequently oppressive and which, ultimately, reinforce the very structures creating ecological damage and hunger. Moreover, by degrading the environment, often irreversibly, the forces which are generating organized scarcity — the chief characteristic of "overpopulation" in the modern era — are inexorably undermining the capacity of the land to produce food. In doing so, they threaten to bring about those conditions of absolute *scarcity where even equitable economic and social arrangements may prove insufficient to prevent widespread human impoverishment.*

Globe, Inc. is "overpopulated". And as long as access to food and other resources is determined by inequitable power relationships, it will remain so. Because no matter how much food is produced, how few babies are born or how dramatically human numbers fall, it is the nature of the modern market economy remorselessly to generate "scarcity". Blaming such socially-generated scarcity and ecological degradation on "overpopulation" or "underproduction" has long provided the more powerful with an explanation for human misery that does not indict themselves and that legitimizes various ideologies of exclusion. Without changes in the social and economic relationships that currently determine the production, distribution and consumption of food in the world, there will always be those who are judged "surplus to requirements" and who are thus excluded from the wherewithal to live. The human population could be halved, quartered, decimated even, yet hunger would still remain. So long as one person has the power to deny food to another, even two people may be judged "too many".

Recognizing the existence of socially-generated scarcity — insufficient necessities for some people and not others — is not to deny *absolute* scarcity —insufficient resources, no matter how equitably they are distributed. We live on a finite planet and there are, incontrovertibly, limits to the ability of the earth to accommodate human numbers, pollution, resource depletion and other demands on its "ecological services". It is, however, to insist that differentiating between socially-generated scarcity and absolute scarcity is a *sine qua non* for any sensible discussion of the causes of food insecurity (*see* Box, p.283).

The Experience of Scarcity

Scarcity — in the sense of a dearth of food or other necessities — is not a new phenomenon. Throughout history, communities have had to contend with failed harvests or disturbances such as war which have led to food insufficiencies. But not everyone experiences this scarcity in the same way: who gets to eat and who goes hungry during periods of insufficiency has

Scarcity and Scarcity

To accentuate and explore *socially-generated* scarcity — insufficient necessities for some people and not others — is not to deny *absolute* scarcity — insufficient resources, no matter how equitably they are distributed. We live on a finite planet and there are incontrovertible limits to the ability of the earth to accommodate human numbers, pollution, resource depletion and other demands on its ecological services. Nonetheless, it is critical that the two types of scarcity be differentiated. As historian and social critic Andrew Ross remarks:

> "For more than two decades now, public consciousness has sustained complex assumptions about both kinds of scarcity. In that same period of time, however, neo-liberalism's austerity regime has ushered in what can only be described as a pro-scarcity climate, distinguished, economically, by deep concessions and cutbacks, and, politically, by the rollback of 'excessive' rights. As a result, the new concerns about natural [or absolute] scarcity have been paralleled, every step of the way, by a brutal imposition of social scarcity. More often than not . . . the two kinds of scarcity have been confused, either deliberately, in order to reinforce austerity measures against the poor, or else inadvertently, through lack of information and education about how natural resources are produced and distributed."

Ross points out that it is important to distinguish the ways in which one type of scarcity is related to the other and the ways it is not, so as forge appropriate responses. He continues:

> "Resource shortages and ecological degradation are primarily a result of the uneven social measures that manufacture scarcity all over the world for the economic and political gain of powerful interests. The systematic inequalities that block peoples' access to income, health, education, and democratic rights are primarily responsible for the geographical and sociological profile of the ecology crisis. In those instances where ecological [or natural or absolute] scarcity appears to harbour no direct connection with social scarcity, its character is defined by economic forces which are nonetheless fundamentally linked to the social and cultural tendencies that fuel pro-scarcity politics. In sum, there is no easy separation of the two kinds of scarcity."

Food scarcity is just one example to illustrate the point. Undoubtedly "natural" events such as floods and droughts play a part in ruining harvests and thus in creating hunger and malnutrition. So too does the ecological degradation that results when people are crowded onto marginal lands and cannot produce enough food for themselves.

But in an age of human-induced climate change and of huge hydroelectric and irrigation construction projects that divert whole river systems, neither droughts nor floods can be viewed as entirely "natural" events. Similarly, the forces that lead people to settle on marginal lands cannot be separated from policies and practices that daily generate scarcity for some people by denying them control over land, inputs, markets and decision-making.

Source: Ross, A., "The Lonely Hour of Scarcity", *Capitalism, Nature, Socialism*, Vol. 7, No. 3, September 1996.

always depended on the ability of households and individuals to gain access to food,[1] and hence on the distribution of economic and political power within a community and the wider society.

In commons-based regimes,[2] where the management of land is a community affair, scarcity and its resulting hardship tend to be a shared phenomenon because the survival of all depends upon no one putting any one else in the community at risk. Working the land, for example, tends to be a co-operative business, with richer farmers just as bound by reciprocal labour arrangements as poorer farmers. Likewise, the joint management of water and other resources means that farmers are under intense social pressure to respect the rights of each other if their own rights are to respected. The commons' culture of joint "ownership" and responsibilities therefore limits the ability of any one group or individual to exercise institutional power over others.[3] This does not means that everyone is equal in the commons: gender, class and caste inequalities, for instance, certainly exist, both between households and within households. In general, however, a rough equity prevails in which everyone has some degree of bargaining power. Thus no one is likely to starve whilst others are comfortable.

In market-based regimes, people's experience of scarcity is very different. In an undiluted market economy, access to food is no longer dependent on being part of — and contributing to — a social network: instead, food goes to those who have the money to buy it. Only those who, in the economists' jargon, have the income to translate their biological needs into "effective demand" get to eat. In today's global supermarket, people earning $25 a year — if they are lucky — must compete for the same food with people who earn $25 a hour, or even $25 a minute.

It is this market logic — and the power structures that drive it — that lies behind the paradox of people starving despite abundant local harvests; that explains why shiploads of grain were exported daily from the famine-stricken Horn of Africa during the 1980s to feed already well-fed Europeans; that ensures that cats and dogs belonging to European pet owners can be better fed than children of low-paid or unemployed European workers; that condemns an estimated 800 million people (including two million children in the UK alone) to malnutrition and hunger; and that ensures that, for many people, the experience of scarcity — insufficient food — is not a *temporary* phenomenon. Nor, as was typically the case in commons regimes, is it a phenomenon more or less shared by all; it has become a perennial feature of life for an increasing number of people.[4]

The deliberate manufacture of scarcity now provides one of the principal means through which state and private interests "monopolize resources, control markets and suppress the demographic majority".[5] Such use of scarcity as an instrument of "population control" — in its sense of "controlling people" — is not unique to free market economies or to any one historical era. It is,

however, only possible in societies where elite interests — whether state apparatchiks, feudal landlords, colonial sahibs, military wannabes or corporate executives — have managed, more or less, to deny the majority of people control over the resources and markets on which their livelihoods depend.

Generating Scarcity of Land

Historically, control over land has always been vital to the livelihoods of the world's poorest people. Lack of access to land not only denies people the ability to grow or to gather their own food: it is also excludes them from a source of power. Who controls the land — and how they do so — affects how land is used and to whom the benefits for its use accrue.[6]

Highly-concentrated land ownership is now a feature of agriculture in both North and South. In the US, nearly half the country's farmland is held by just 124,000 corporations or individuals — just four per cent of the total number of farm owners.[7] In Guatemala, 65 per cent of the best agricultural land is owned by just two per cent of the population[8] — a figure that is not atypical for other countries in Central America. In Brazil, a mere 340 of the largest landowners, many of whom are foreign-owned transnational companies, own more land than all the country's peasants put together. The 18 largest landowners own an area equivalent to that of The Netherlands, Portugal and Switzerland combined. In the Philippines, five per cent of all families control 80 per cent of the agricultural land, despite seven land reform laws since 1933.[9]

The corollary of such concentration of land ownership in the hands of the few is land scarcity for the many. In the Philippines, about 72 per cent of rural households (three-fifths of the Philippine population) are landless or near-landless. Tenant farmers must contend with rents which account for between 25 and 90 per cent of their

From Colonialism to Land Reform to Privatization

Land concentration in many countries of the Third World and its corollary, socially-generated land scarcity, are linked to the experience of colonialism and the development policies subsequently pursued by many post-Independence governments.

It was standard practice for the majority of colonial administrations to declare that "uncultivated" land was their property. At a stroke, many local communities were denied legal title and access to land they used to leave fallow in rotational cultivation systems and to the forests, grazing lands and streams they relied upon for hunting, gathering, fishing and herding.

Where the lands that colonial authorities sought to exploit were "cultivated", the indigenous population were restricted to tracts of low quality land. In Kenya, "reserves" were "structured to allow the Europeans, who accounted for less than one per cent of the population, to have full access to the agriculturally rich uplands that constituted 20 per cent of the country." In Southern Rhodesia, the colonists, who constituted five per cent of the population, became the new owners of two-thirds of the land. In Northern Rhodesia, the policy of reserving the best land for European agriculture was explicit, the 1932 Agricultural Survey Commission stating that:

> "Any land that had poor soils, inadequate water supplies, low nutrition grasses unsuitable for European cattle or [was] overgrown with impenetrable bush, was not suitable for Europeans and should be allocated to Africans."

The lands appropriated by colonial administrations were typically leased out to commercial concerns for plantations, mining and logging, or sold to white settlers.

In India, the British designated vast tracts of forest as "reserve forests". Villagers' rights of access were curtailed and large areas logged to supply timber for ship-building and sleepers for the expanding railway system. In French Equatorial Africa, 70 per cent of the country had been leased to just 40 companies by 1899, with one company receiving 140,000 square kilometres.

Land and Labour

The various colonists needed labour to work the land they had appropriated. But as long as subsistence farming remained viable, few were willing to work for next-to-nothing in the appalling conditions of the mines and plantations. In Southern Africa, white settlers complained until well into the twentieth century that they could not secure sufficient numbers of local people willing to take up paid labour. Many colonial powers thus sought to generate land scarcity by deliberately using price controls, taxation and land appropriation to compel reluctant populations into the labour market.

In Southern Rhodesia, for example, rich soil and ample land enabled local peasants in some areas not only to feed their own households but to make a good living supplying local mining communities with grain and food. Women made substantial profits selling beer brewed from maize. From 1912 onwards, a series of laws were implemented that rapidly eroded households' ability to provide for themselves from their own land. As Carol Thompson of the University of California records:

> "First a land bank was established to attract white settlers; they were offered loans up to £2,000 — with subsidized fertilisers, seeds, livestock and roads for transport. In contrast, other laws alienated land from the Africans, relegating them to the worst land, often remote from the transport systems and markets . . . By 1920, the demand for land by whites was sufficient to reduce African holdings by one million acres of the best land in all of Southern Rhodesia."

The 1921 Maize Control Act required Africans to sell their maize to the Maize Control Board rather than to the mines and cities where higher prices could be obtained. The Board often delayed payment for the grain until after taxes were due, depriving peasants of cash and forcing them into debt. Other means of earning cash were restricted in 1936 when the government barred Africans from selling vegetables, chickens, eggs and butter in European areas of Rhodesia's towns. The net effect of such measures was to drive men off the land and into work in the mines or on commercial farms, often at rates that undercut even forced labour.

production costs. Usury at rates of 100 per cent in three months or 50 per cent in one month is common. Half of all those who make a living from agriculture are farm workers, often earning as little as $1 a day.[10]

In Central America as a whole, small and medium-sized farms producing for local consumption and local sale represent about 94 per cent of existing farms but use only 9 per cent of the farmland. Meanwhile, 85 per cent of the best farmland is used to grow crops for export.[11]

In Costa Rica, 55 per cent of all rural households are landless or near landless, whereas the cattle owned by 2,000 politically-powerful ranching families occupy more than half of the nation's arable, most fertile land.[12] As in other countries throughout the region, smallholders have been pushed from their land into areas where soils are poor and prone to erosion.

In Guatemala, huge swathes of land owned by the biggest landlords — an estimated 1.2 million hectares — lie idle, either because the price of export crops is too low to justify planting or because the land is being held simply for speculation.[13] Meanwhile, some 310,000 landless labourers over 20-years of age are without permanent employment.[14] A complicating factor is that ownership or continued access to land is not secure for many people. Some 22 per cent of farms in the country are held by squatters with limited rights.

Landlessness and poverty go hand-in-hand. Eight out of ten farmers in the Central America do not own enough land to sustain their families, forcing them to look for seasonal jobs. In Guatemala, government figures from the mid-1980s estimated that 86 per cent of families were living below the official poverty line, with 55 per cent classified as "extremely poor". Rates of malnutrition reflect these figures: a national survey in 1980 found that only 27 per cent of all children between six months and five years showed normal physical development, with 45 per cent showing moderate to severe retardation in their growth.[15]

From Land Scarcity to Land Scarcity

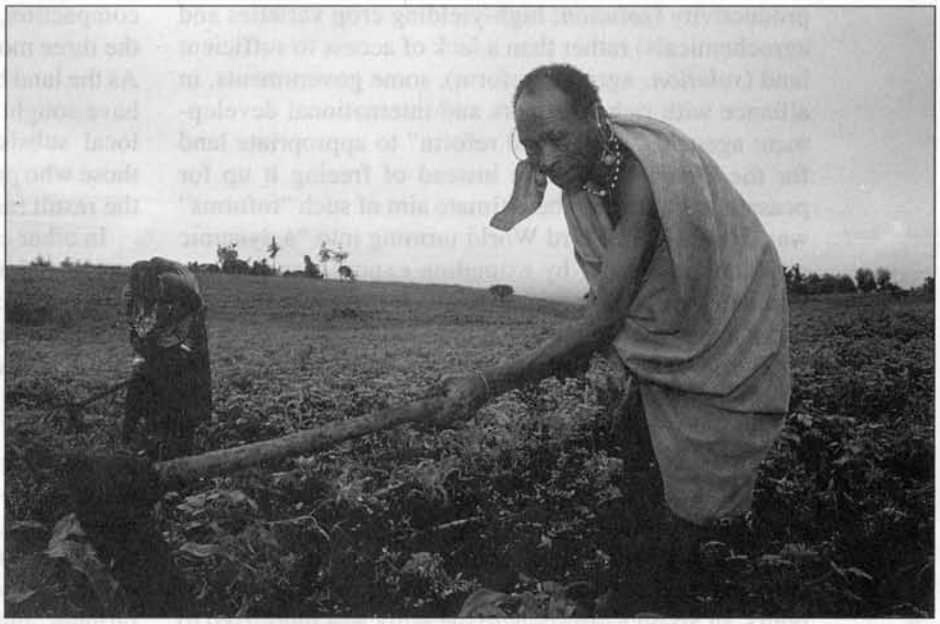
In most countries, the demise of direct colonial rule has done little to correct either the imbalances of power that colonialism generated and exacerbated, or the land scarcity that resulted (with the exception of Cuba and a minority of others).

Many governments have either reneged on promises of land reform or have used land reform programmes to serve the institutional and political aims of a small elite. In Kenya, for instance, where dispossessed farmers formed the backbone of the Mau Mau nationalist movement in the 1950s, Jomo Kenyatta rapidly sidelined land reform as a political priority when he became President in 1963. Although it was agreed under the terms of Kenya's independence from Britain that one million acres of land previously "owned" by Europeans would be transferred to some 25,000 landless and unemployed African families, the beneficiaries often comprised absentee civil servants rather than the landless. No attempt was made to redress the loss of women's traditional rights to land: on the contrary, the colonial system of investing land titles in men — the presumed "head of the household" — was continued.

Similarly, once Jawaharlal Nehru's government was in power in India, it turned its back on the demands for radical land reform which had been integral to the involvement of many peasants in the Independence movement. Although measures were introduced throughout the country in the early 1950s to provide security of tenure to tenants and to limit the size of land holdings, many landlords exploited loopholes in the legislation to maintain their holdings or to deny tenants their rights — not least by evicting millions from their land prior to enactment of the legislation. In many states, implementation of the legislation was effectively blocked by local elites or rendered toothless through delaying tactics which lasted months, if not years.

Even in those areas where it is claimed land reform programmes have been a success, reforms have generally proved piecemeal and short-lived. In West Bengal, for example, "land reform and tenancy control laws were executed by a local bureaucracy largely indifferent, occasionally corrupt and biased in favour of the rural oligarchy . . . Quite frequently, protective tenancy legislation may have worsened the conditions of tenants."

More recently, landlessness and land concentration has been exacerbated as a result of IMF-imposed structural adjustment programmes and schemes aimed at privatizing common lands. The Kenyan government's aggressive pursuit of land privatization, for example, has proved highly prejudicial to pastoral groups such as the Maasai.



Adrian Arbib/Still Pictures

A Maasai man and woman cultivate their land. Since 1963 when private land tenure was imposed on all communal land in Kenyan Maasailand as part of a World Bank-sponsored scheme to promote commercial ranching, Maasai herders have been systematically deprived of their rangelands. Those who have kept their cattle have been forced to graze them on ecologically-fragile lands, resulting in degradation; others have turned to crop cultivation.

Modernization and Scarcity

Land concentration in the Third World is not accidental (*see* Box, p.284). It has always been fiercely resisted, not least by popular movements demanding land redistribution. Imbalances of power, however, have enabled landowners to ensure that, by and large, land reform programmes have either been put on hold, subverted or short-lived. In other instances, they have been framed, not as a means of addressing insecurity of tenure, but as a means of replacing peasant systems of farming with industrialized agriculture.

"Food scarcity has always primarily been about politics and the exercise of power"

By defining rural poverty in terms of insufficient productivity (*solution*: high-yielding crop varieties and agrochemicals) rather than a lack of access to sufficient land (*solution:* agrarian reform), some governments, in alliance with richer farmers and international development agencies, used "land reform" to appropriate land for the Green Revolution instead of freeing it up for peasant agriculture. The ultimate aim of such "reforms" was to transform Third World farming into "a dynamic productive sector"[16] by extending export crop production and by drawing peasants still further into the cash economy where they were at a disadvantage.

The promotion of off-farm inputs — chemical fertilizers, pesticides and improved seeds — has forced farmers to buy what was previously free, in addition to locking them into a cycle of diminishing returns on fertilizers and increasing pesticide use. As a result, thousands of small farmers — including those who had gained land under previous land reform programmes — have fallen into debt and their land holdings bought up by richer neighbours. In South Korea, where the army was mobilized to rip up traditional varieties of rice and to compel farmers to plant Green Revolution varieties, the number of rural households in debt rose "from 76 per cent in 1971 to 90 per cent in 1983 and to an astounding 98 per cent in 1985."[17] As a result, farmers have left the land in droves: 34,000 migrated to the cities in 1986, 41,000 in 1987 and 50,000 in 1988. Many of the farmers who remain have now abandoned the new varieties and are returning to planting traditional seeds.

Thus, for marginal groups of people, the promotion of Green Revolution technologies — the hallmark of "efficient" farming — has generated yet more scarcity of land and of food as the land becomes further concentrated in fewer and fewer hands.

Ecological Degradation

Widespread ecological degradation has also followed the systematic undermining of ecologically-sound systems of agriculture and the adoption of Green Revolution techniques. Such degradation is now in itself a major cause of socially-generated scarcity. In the Sudan, for example, the combination of mechanized farming, monoculture growing and the search for quick profits has caused an estimated 17 million hectares of rainfed arable land — almost half the country's potential arable land — to lose its topsoil. As Mohamed Suliman of the Institute for African Alternatives reports:

> "Traditional agriculture in the Sudan follows crop rotation systems and fallow periods to conserve and regenerate the fragile land . . . The absentee owners of mechanized farms, however, are interested in quick economic returns: knowing that they can move on to new areas, migrant workers employed on these farms tend to neglect the fallow period prescribed by the government and grow the same crop on the same piece of land for several years."[18]

Productivity is high in the first two to four years, after which yields start to decline: the severely exhausted and eroded land is abandoned around the seventh year when yields fall below profitable levels. The area east of the Nile has been most affected. Loss of tree and plant cover there has exposed the clay soils to wind erosion and compaction, enhancing surface run-off, particularly in the three months when rain falls, often in heavy storms. As the land becomes degraded, so the mechanized farms have sought to expand on to lands farmed or grazed by local subsistence farmers, creating land scarcity for those who previously had sufficient land. In many cases, the result has been open conflict.

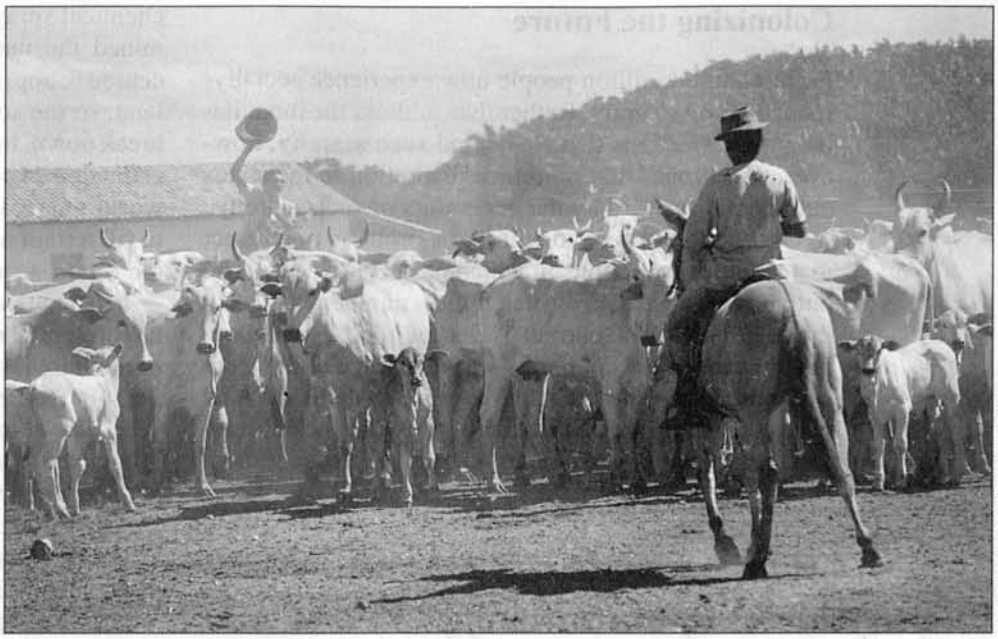
In other countries, the expansion of irrigated agriculture, a major feature of the Green Revolution, has led to similar scarcity. Industrialized irrigation agriculture has caused widespread salinization of soils and been a major factor in reducing the availability of water to poorer peasants. In central India, for example, the preferential diversion of limited groundwater supplies to richer farmers growing sugar cane and grapes has created severe water scarcity for poorer sections of the community. In many states, the mining of groundwater for commercial agriculture has led to groundwaters declining by 5-10 metres, generating a scarcity of water for subsistence farmers and villagers whose water demands (unlike those of large industrialized farms) are minimal. In the state of Maharastra, some 23,000 villages are now without water, while in Gujarat the figure is 64,500 villages. In such areas, access to water is increasingly restricted to those who can afford to deepen their wells regularly.[19]

Scarcity and the Market

As land and water become increasingly degraded, and control over such resources increasingly concentrated, so the livelihoods of peasant farmers, the landless and the near-landless become increasingly precarious. No longer able to rely on growing their food, the vast majority have to buy their food. How much and what they get to eat depends on their ability to earn money or on the state's willingness to support them. For the World Bank and other development agencies, this necessity has frequently been interpreted as evidence of the need to integrate Third World agriculture still further into the global economy so as to increase the income of farmers and to generate rural and urban employment.

Yet, as economist Amartya Sen points out, the creation

of famine and hunger results not from the *exclusion* of the marginalized from markets (they have always marketed goods) but from the *normal* working of markets. In his classic text, *Poverty and Famines*, Sen stresses that the famines which decimated peasants in India in 1943 and in Ethiopia, the Sahel and Bangladesh in 1974 were not the result of market failures, but of those market and non-market mechanisms (including the ownership of resources) which undermine the ability of poorer sections of the community to command goods on the market.[20] The terms on which people come to the market — and in particular their ability to exercise control over resources and trade — are thus critical to whether they experience scarcity as starvation and famine.[21]



Mark Edwards/Still Pictures

Cattle ranching in Brazil. It is not just land policies which generate scarcity; other policies too are pushing the whole process of food production and distribution in a direction which continues to entrench the power of specific interest groups while undermining the bargaining power of others. Subsidies, credit and agricultural research, for instance, tend to be directed towards those with the greatest lobbying power. In Costa Rica, the cattle ranching industry has cornered 40 per cent of all agricultural credit even though it produces scarcely ten per cent of the country's agricultural output.

The development policies pursued by Third World countries, under the tutelage of the IMF and the World Bank, have dramatically undercut the bargaining power of poorer people within the market. The growing pool of landless labourers, many of whom are women, means that the rural poor must compete for jobs in a "buyer's market", giving employers the upper hand in determining wages and working conditions. Real wages for labourers have been rapidly declining in many Third World countries.[22] As writer and researcher Jon Bennet remarks of the estimated 1.75 million seasonal labourers who compete for work in the cotton growing areas of Sudan:

> "Stripped of their traditional means of support, farmworkers [have] become simply *components of production*. . . . increasingly vulnerable to the shifting fortunes of an economy outside their control. As a seemingly limitless resource with minimal bargaining power, they [can] now be hired or fired at will."[23]

Those working as labourers in export-crop plantations have been particularly vulnerable to exploitative wages and working conditions. Because exporters rely on markets abroad rather than at home for the sale of their crops, low wages are not "necessarily so bad for business" since "profits do not necessarily significantly depend on the ability to sell domestic products to wage earners or peasants".[24]

Scarcity Under Contract

Even where peasant producers do have access to land, they may be hardly better off than landless labourers in an economy over which they have little control. Increasingly, large corporate producers are moving away from direct ownership of land towards indirect control through contracts with peasant smallholders. Under the terms of the contract, a company agrees to buy given quantities of crops of particular specifications at a fixed price in return for supplying inputs and advice. The peasants retain ownership of their land, but have to abide by the conditions set by the company regarding cultivation, marketing and pricing, if they are to sell the crop.[25] The risks of production, heightened by unstable global markets, are thus transferred to the peasant, who becomes, in effect, a tied-labourer for the company.

Companies are also opting for "outgrower schemes" whereby independent producers supplement output from company plantations. Either way, peasants become increasingly dependent for their livelihoods on corporations, whose buying power is used to drive down prices and to impose strict conditions not only on what is grown but how it is grown.

The Kenyan state-managed Mwea Rice Scheme, in which peasant plots are grouped together to enable block farming, typifies the problems faced by smallholders growing export crops in such schemes. As researcher Philip Raikes reported in the late 1980s, malnutrition was "serious and persistent" among women and their children because the scheme denied them land on which to grow their own food-crops.[26]

Moreover, because the onus of finding and organizing the labour force is placed on the contracted grower — generally the male head of household — contract farming can create new tensions, resulting in increased divorce, domestic tension, and the renegotiation of family and marital responsibilities."[27] Such intra-household tensions can further disadvantage women whose access to food *within* households, even within relatively equitable commons regimes, has historically been skewed by gender biases. Food owned by the household, for example, is not always shared equally: gender subordination results in women often being the last to eat and explains why, in a number of recent incidence of famine, food shortages have resulted in women being "neglected, abandoned, divorced and sold into prostitution in the interests of male survival."[28]

Colonizing the Future

Eight hundred million people now experience socially-induced food scarcity. Rather than address the inequitable power relations that lie behind such scarcity, however, "solutions" that minimize disruption to the status quo are put forward by the generators of such scarcity.

One tactic has been to reduce the problem to abstract mathematical equations in which projected agricultural output is set against projected human numbers to justify the continuance of current forms of food production. Factors that do not compute — a wide range of different and interacting power relationships, systems of land tenure, food grown and traded outside the formal markets, and so on — are simply left out of the equation.

"Where people can rely on networks of mutual support and rough equity ensures that markets are kept under social control, hardship is shared. Where power is unequal and systems of support have been undermined, people starve."

Backed by "the amoral authority of numbers",[29] such quantitative assessments of global food budgets are powerful tools in colonizing the future for specific interest groups. Legitimate concerns about future rates of population growth, for example, are regularly harnessed to insist that current policies aimed at industrializing agriculture must be pursued more aggressively. Estimated projections for population increases are thus set alongside figures of declining output (usually guestimates based on *officially marketed* agricultural produce) to argue the case for an overall increase in pesticide and fertilizer use and the employment of genetically engineered crops — or to dismiss traditional "low external input technologies" as inadequate to meet the challenge of feeding an extra 2.5 billion people in the next 30 years.[30] The myriad ways in which production could be increased using labour-intensive, organic methods of agriculture are steadfastly ignored,[31] as is the increasing tendency for many peasants to sell their crops on the black market or to consume the food themselves — produce which is not accounted for in official output estimates.

In the absence of radical change to current economic and social structures, however, increased output — whatever way it is achieved — will not translate into increased numbers of people fed. In a world in which scarcity is continually generated as an unavoidable — some would argue, deliberate — feature of the food system, the experience of hunger will only increase.

In addition, by inexorably undermining the capacity of land to produce food, the ecological damage caused by intensive farming is creating the conditions for absolute scarcity — where even equitable economic and social arrangements may prove insufficient to prevent widespread human impoverishment. Artificial fertilizers and chemical sprays, for example, have disastrously undermined the natural fertility of soils. As farmers have ceased to apply manure and other organic material to the land, so the soil's structure in many areas has begun to break down, increasing its vulnerability to erosion — an estimated 24 billion tonnes of soil being eroded from the world's agricultural lands every year. This is enough soil to fill a train of freight cars stretching from the Earth to the Moon — and back again — five times.

In arid areas, the introduction of perennial irrigation has brought the added problem of salinization. Irrigation agriculture is one of the most productive forms of farming, but the irrigation of poorly drained land, year after year, has waterlogged the soils, causing salts in the groundwater to rise to the surface, where they accumulate, turning vast stretches of farmland into salt-encrusted desert. In many areas, irrigated land is now so severely degraded that it is unfit for agriculture.

Nonetheless, FAO argues that the achievement of increased cropping intensities and higher yields "depends crucially" on maintenance of irrigation and its further expansion by 23 million hectares. Greater use of pesticides and fertilizers is also predicted. FAO also argues that some 800 hectares of tropical forest will have to be converted to agriculture[32] — a change of land use that has dramatic implications for climate change (*see* this issue pp.290ff).

Meanwhile genuine concerns about the impacts of environmental degradation, coupled with concerns over population growth, are being reworked by some policymakers to legitimize yet further land enclosure. FAO, for example, has proposed that, in the interests of "environmental protection" and "sustainability", all national governments should "zone" agricultural lands, rangelands and forests. Under this policy, "high potential areas" (that is, the most fertile areas) would be set aside for intensive export crop monocultures or livestock rearing and the "carrying and population supporting capacity of major agricultural areas" assessed. Where such areas are deemed to be "overpopulated", steps should be taken to change "the man/land ratio" by "facilitating the accommodation of migrating populations in better endowed areas."[33] Peasants who have been forced on to marginal lands as a result of "high potential areas" being taken over for intensive export-orientated agriculture would thus be liable to resettlement at the whim of any government which deemed them a threat to "the environment". FAO does not even consider the possibility that ecological stress would be better relieved by reclaiming "high potential areas" for peasant agriculture.

Two Too Many

Discussions of population and food supply which leave out power relations will always mask the true nature of food scarcity — who gets to eat and who doesn't — and lead to "solutions" that are simplistic, technocratic, frequently oppressive and gender-blind — all of which, ultimately, reinforce the very structures that create ecological damage and hunger. To reiterate: so long as one person has the power to deny food to another, even two people may be judged "too many". Recognizing that fact — and putting equity at the centre of the debate — is a *sine qua non* for any sensible discussion of the causes of food insecurity and food scarcity.

1. Sen, A., *Poverty and Famines: An Essay on Entitlement and Deprivation*, Clarendon, Oxford, 1981.
2. For a discussion of commons regimes, *see* "Whose Common Future? Reclaiming the Commons", *The Ecologist*, Vol.22, No.3, 1992.
3. Ibid. The rough equity which generally prevails in the commons does not grow out of any ideal or romantic preconceived notion of "communitas" any more than out of allegiance to the modern notion that people have "equal rights". Rather, it emerges as a by-product of the inability of a small community's elite to eliminate entirely the bargaining power of any one of its members, the limited amount of goods any one group can make away with under the others' gaze, and the calculated jockeying for position of many individuals who know each other and share an interest both in minimizing their own risks and in not letting any one of their number become too powerful.
4. Xenon, N., *Scarcity and Modernity*, Routledge, London, 1989, p.3. As Xenon notes, "Of medieval origin, 'scarcity' derives from the Old North French *escarceté*. Its original usage denoted an insufficiency of supply, and by the fifteenth century the word took on a more specific meaning as an insufficiency of supply of necessities, or a dearth. At the same time, the term acquired a clear temporal characteristic signifying a *period* of insufficiency or *a* dearth. This remained the principle usage until the late nineteenth century, when neo-classical economics made the scarcity postulate its foundation and the term passed into general usage through its transformation into a concept signifying a general condition: not a 'scarcity of', or 'a time of scarcity', but simply "scarcity"."
5. Ross, A., "The Lonely Hour of Scarcity", *Capitalism, Nature, Socialism*, Volume 7, No.3, September 1996, p.6.
6. Tansey, G. and Worsley, T., *The Food System: A Guide*, Earthscan, 1995, p.87.
7. Krebs, A.V., *The Corporate Reapers: The Book of Agribusiness*, Essential Books, Washington DC, 1992, p.60.
8. Colchester, M. "Guatemala: The Clamour for Land and the Fate of the Forests" *in* Colchester, M. and Lohmann, L., (eds.) *The Struggle for Land and the Fate of the Forests*, World Rainforest Movement/ The Ecologist, Zed Books, London, 1993, p.113.
9. Marvic Leonen, "The Philippines: Dwindling Frontiers and Agrarian Reform", *in* Colchester, M. and Lohmann, L., (eds.) op. cit. 8, p.275.
10. Ibid., p.274.
11. Barry, T., *Roots of Rebellion: Land and Hunger in Central America*, South End Press, Boston, 1987, p.xiv.
12. Durning, A.B., *Poverty and the Environment: Reversing the Downward Spiral*, Worldwatch Paper 92, Washington DC, 1989, cited in Wachter, D. and North, N, *Land Tenure and Sustainable Management of Agricultural Soils*, Centre for Development and Environment, Institute of Geography, University of Berne, Switzerland, 1996, p.6.
13. The problem is a general one. See, for example, Putzel, J. and Cunningham, J., *Gaining Ground: Agrarian Reform in the Philippines*, War on Want, London, 1989, p.35.
14. Colchester, M., op. cit. 8, p.114.
15. Ibid., p.120.
16. Alexandratos, N., (ed.), *World Agriculture: Toward 2000. An FAO Study*, Belhaven Press, by arrangement with FAO, London, 1988.
17. Bello, W. and Rosenfeld, S., *Dragons in Distress: Asia's Miracle Economies in Crisis*, Institute of Food and Development Policy, Food First, San Francisco, 1990, p.86.
18. Suliman, M., "Civil War in the Sudan: From Ethnic to Ecological Conflict", *The Ecologist*, Vol.23, No.3, May/June 1993, p.106.
19. Bandyopadhyay, J., "The Ecology of Drought and Water Scarcity", *The Ecologist*, Vol.18, Nos 2/3, 1988, p.93.
20. Sen, A., op. cit. 1. See also Mackintosh, M., "Abstract Markets and Real Needs" *in* Berstein, H., Crow, B., Mackintosh, M. and Martin, C., *The Food Question: Profits versus People?*, Earthscan, London, 1990, pp.44-45.
21. Mackintosh, M., op. cit. 20, p.44.
22. The effect, and some would say the purpose, of the extravagant pattern of land holdings found in many countries is to ensure a ready availability of labour for work on estates. Since the majority of the small farms cannot themselves provide a living — particularly when taxes and other demands are taken into account — many peasants have to find off-farm employment to support themselves.
23. Bennet, J., with George, S., *The Hunger Machine*, Polity Press/ Basil Blackwell, Oxford, 1987, p.59.
24. O'Brien, J. and Gruenbaum, E., "A Social History of Food, Famine and Gender in Twentieth-Century Sudan" *in* Downs, R.E., Kerner, D.O. and Reyna, S.P., *The Political Economy of African Famine*, Gordon and Breach, Reading, 1991, p.178. O'Brien and Gruenbaum point out that domestic traders too may have an interest in keeping wages low. In the mid-1980s, for example, "Mass starvation in the rural areas had become one of the most profitable businesses in the Sudan in the form of hoarding of and black marketering in foodstuffs."
25. Halfani, M.S. and Baker, J., "Agribusiness and Agrarian Change" in Barker, J., (ed.), *The Politics of Agriculture in Tropical Africa*, Sage Series on African Modernization and Development, Volume 9, Sage Publications, London, 1984, p.48.
26. Raikes, P., *Modernizing Hunger*, Catholic Institute for International Relations, in collaboration with James Currey, London, 1988, p.57.
27. Watts, M. J., "Living Under Contract: The Social Impacts of Contract Farming in West Africa, *The Ecologist*, Vol. 24, No.4, July/August 1994, p.130.
28. For further discussion, *see* contributions in Downs, R.E., Kerner, D.O. and Reyna, S.P., op. cit. 24; and Berstein, H., Crow, B., Mackintosh, M and Martin, C., op. cit. 20.
29. Ross, A., op. cit. 5, p.20.
30. World Bank, *Agricultural Action Plan — From Vision to Action in the Rural Sector*, Office Memorandum from Caio Koch-Weser to James Wolfensohn, 23 February 1996, p.1.
31. Intensifying agriculture by applying more fertilizers and pesticides to monocultures is often a less effective way of increasing output per acre than adopting labour-intensive polycultures which harness natural biological cycles.
32. Food and Agriculture Organization of the United Nations, *Agriculture: Towards 2010*, FAO, Rome, 1993, p.13.
33. FAO/Ministry of Agriculture, Nature Management and Fisheries of The Netherlands, *Sustainable Agriculture and Rural Development, Draft Proposals*, 's-Hertenbosch, The Netherlands, p.16: FAO/ Ministry of Agriculture, Nature Management and Fisheries of The Netherlands, *The Den Bosch Declaration and Agenda for Action on Sustainable Agriculture and Rural Development*, 's-Herten–bosch, The Netherlands, p.9.

Industrial Agriculture — Driving Climate Change?

Peter Bunyard

Climate change is happening — that's official. Nonetheless, most agronomists argue that human societies can weather the storm without drastic changes to industrialized patterns of farming. Such claims, however, overestimate industry's contribution to climate change and underplay the impact of modern agriculture on climate. By degrading soils and changing patterns of land-use, agriculture is disrupting the ability of climate to recover from the perturbations caused by greenhouse gas emissions. The change in rainfall patterns that accompany land degradation, especially in the drylands, is leading to increased water stress and, consequently, towards conditions where terrestrial vegetation may be losing its powers to modulate climate and thus prevent runaway warming.

Few people now seriously doubt that the earth's climate is changing and that we are sliding inexorably into a period of climatic instability. Unless drastic action is taken to reduce anthropogenic emissions of greenhouse gases (such as carbon dioxide, methane and nitrous oxide), warns the latest report of the Intergovernmental Panel on Climate Change — IPCC (the UN body charged with assessing the causes and likely impacts of climate change), average surface temperatures will rise by between 1.5°C and 4.5°C by the end of the next century.[1] To put that rise in perspective: over the past two million years, temperatures on earth have never been more than 2°C warmer than at present. Within a century — hardly any time at all in the history of the earth — our descendants and those of other living creatures could face temperatures well outside their evolutionary experience. The implications for many species, including humans, are potentially catastrophic.

Notwithstanding the magnitude of the threat, the IPCC argues that humanity can survive global warming, at least in terms of food supply. Although its scientists acknowledge that global warming will increase crop pests and weeds, dry out soils, increase soil erosion and decrease soil fertility, the IPCC concludes that new technologies and changes in cropping practices will enable farmers to combat, or even reverse, the most deleterious effects of climate change. Certainly, it concedes, some regions (particularly drylands in the South) are likely to suffer severe hardship: but, overall, it maintains that the beneficial effects of carbon dioxide in stimulating plant growth will make-up for losses in drought-prone regions (*see* Box, p.293). Given nutrients and water, most of the world's major crops (with the exception of the so-called C-4 plants: maize, sugar cane, millet and sorghum) are predicted by the IPCC to thrive under a doubling of carbon dioxide levels, their yields increasing by up to 80 per cent. Hence, the IPCC's confidence that "global agricultural production can be maintained relative to baseline production".[2] Business, it seems, will continue more or less as usual, the industrialized agricultural sector ensuring that yields are maintained regardless of climatic change.

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Simplistic Models

But can we be so sanguine? As the IPCC itself admits, the models on which its assessment is based are crude in the extreme. Not only are they drawn from yield analyses at a limited number of places, but they also take no account of:

> "changes in insect, weeds and disease; direct effects of climate change on livestock; changes in soils and soil-management practices; and changes in water supply caused by alterations in river flows and irrigations".[3]

In themselves, such omissions cast serious doubts over the IPCC's optimistic conclusions. Furthermore, as Martin Parry (one of the main authors of the IPCC assessment of the impact of climate change on agriculture) himself acknowledges, extrapolating future yields from climate models and plant physiology experiments can be highly misleading.[4]

Most likely, global warming will indeed extend the growing season in areas such as the Canadian prairies by about ten days for every degree Celsius rise in surface temperature, thereby reducing the time taken for a crop to mature by about three days and helping to safeguard it from the first frosts of the autumn.

But such extension of the growing season does not necessarily lead to higher yields. In fact, the higher temperatures are likely to force the crop to rush its maturation so that yields are lower. As Parry remarks,

> "a review of results from ten studies in North America and Europe noted that warming is generally detrimental to yields of wheat and maize in these mid-latitude core cropping regions. With no change in precipitation (or radiation), slight warming (+1°C) might decrease average yields by about five per cent (±4 per cent); and a 2°C warming might reduce average yields by about 10 per cent (±7 per cent). In addition, reduced precipitation might also decrease yields of wheat and maize in these breadbasket regions. A combination of increased temperatures (+2°C) and reduced precipitation could lower average yields by over a fifth."[5]

Life and Climate

Most important of all, the IPCC assessment rests on an overly simplistic view of climate. The models used — known as GCMs or General Circulation Models — view climate as primarily a solar-driven process. Life — that is, living organisms and the ecosystems they make up — is interposed in the models simply as a source or sink of greenhouse gases — vegetation will absorb carbon dioxide; decomposers, such as certain bacteria and fungi, will release it. In the models, however, living organisms are regarded as largely detached from the environment around them. Indeed, the assumption in the GCMs is that living organisms will continue to mop up at the same rate a good proportion of each year's human-derived additions to the greenhouse gases produced naturally by the earth's biota. Up to 50 per cent of the anthropogenic greenhouse gases are therefore assumed to be taken out of the atmosphere by a combination of geophysical and biological processes.

In fact, climate is the result of the absorption and reflection by the earth of massive quantities of energy from the sun. How much energy the earth receives depends on several factors: the earth's ever-changing tilt and orbit around the sun; the amount of cloud covering the earth; the amount of water vapour in the atmosphere; the fluid dynamics of turbulence; and on the greenhouse gases in the atmosphere. Albedo — the extent to which the earth's surface reflects away incoming sunlight — is a key factor in the planet's energy balance. The "whiter" a surface is — as a result of ice, snow or dense clouds, for instance — the more light is reflected back into space; the "darker" a surface is — such as the dark leaves of a tropical forest, a bare mountain or the ocean — the more light is absorbed and the warmer the surface becomes.

"Fierce storms in Britain; drought in the US; increasingly frequent and devastating hurricanes in the Caribbean; changes in monsoon times and intensities throughout the tropics; rising sea levels; and the recent succession of warm and dry years all point to a climate undergoing increasingly severe perturbations."

Just as living organisms are critical in affecting the amount of greenhouse gases in the atmosphere, so are they critical in determining the earth's albedo. It is known, for example, that life in the oceans — bacteria and plankton — regulate the amount of oxygen in the atmosphere and therefore how much carbon gets buried in ocean sediments. Living organisms in the form of algae, bacteria, fungi and plant roots accelerate the weathering of continental rocks one hundred- or even one thousand—fold, thereby taking oxygen and carbon dioxide, as well as acid rain components such as sulphur and nitrogen oxides, out of the atmosphere.

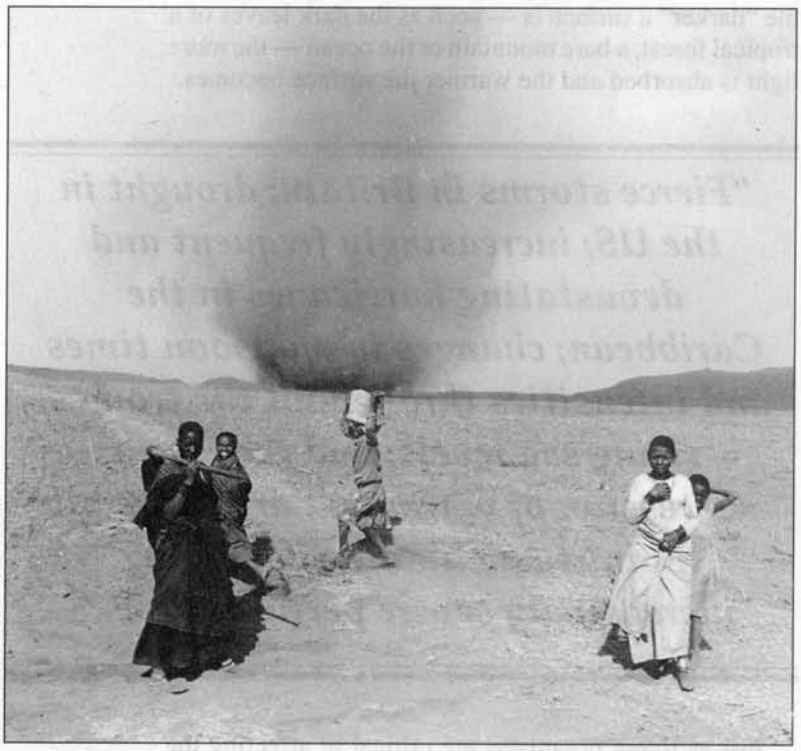
Humans have become major actors on the planet, sequestering (albeit unequally) at least 40 per cent of terrestrial primary plant production. Human societies have so transformed the earth's surface, particularly over the past 50 years, that energy interchanges are inevitably being severely affected. The result must be unpredictable climate change. Most seriously, such disruptions are likely to lead to a host of runaway effects, such as the release of vast quantities of greenhouse gases currently locked up in soils.

Micro-organisms, Mosses and Models

The view that climate can be readily modelled and encapsulated in GCMs is being increasingly challenged. Building on the work of James Lovelock, author of *Gaia: A New Look at Life on Earth*, many climatologists now

believe that climate is an emergent property of a process that depends critically on living organisms and their interactions with their geophysical environment.

To take one example: clouds play a critical role in the heat balance of the earth, simultaneously reflecting solar energy back into space and, conversely, trapping solar energy as heat. How much they do of each of these depends on the nature of the clouds: the whiter they are, the higher their albedo and the more solar radiation they reflect; the thicker and darker they are, the more they serve as a heat blanket.



David Dahmén/Panos Pictures

A storm of top soil comes down the plains of northern Tanzania where overgrazing and frequent cultivation has degraded vast areas of land. By degrading soils and reducing forest cover, current agricultural practices are not only contributing to the build-up of greenhouse gases, but are also disrupting the ability of climate to recover from the perturbations caused by greenhouse gas emissions.

Lovelock and others have shown that without certain nucleating agents around which water vapour can condense, clouds will not form, even though the atmosphere may be supersaturated with water. Over the oceans, such cloud condensation nuclei are primarily associated with organic sulphur compounds, particularly dimethyl–sulphide, which is emitted by certain kinds of marine algae, in particular types of *coccoliths* and *phaeocystis*. Without these organisms, marine stratus clouds are unlikely to form with the result that rain, gathered from the oceans and vital to life on land, would begin to fail. As Lovelock pointed out, global warming is likely to affect life in the oceans and hence the cloud-forming process by reducing the viability of the *coccoliths* and other plankton. That effect, which leads to the ocean layering into a nutrient-deficient surface, is not accounted for in the GCMs the IPCC refers to in its analysis of climate change.[6]

On land, too, living organisms play a central role in determining climate. Lee Klinger of the US National Center for Atmospheric Research in Boulder, Colorado, for example, argues that the humble sphagnum moss may have been responsible in large measure for bringing about past ice ages — a role it could well play again in the future.[7] Klinger has followed plant succession in Alaska and concludes that, slowly but surely, dense coniferous forest yields to coniferous bog forest and finally to moss-sedge bogs, which may then last for thousands of years.

Bog plants tend to acidify the soil through the release of sulphides which form acids when they are oxidized. Acidity favours mosses against other plants, not only stimulating the growth and spread of sphagnum, but also favouring the accumulation of peat by preventing the bacterial decomposition of organic matter — thus locking up huge quantities of carbon and helping to cool the climate.

The result is a self-reinforcing process, with cooler conditions favouring the advance of peatlands which, by holding water, generate mists that themselves significantly increase the albedo, which in turn causes a further cooling. Klinger speculates that the cycle gets broken by the very success of the sedge mosses.

Thus, in the equation of carbon dioxide drawdown and the burial of organic carbon, oxygen gets released into the atmosphere and tends slowly but surely to rise. Higher oxygen levels mean that peatlands dry out and become more susceptible to burning, causing carbon dioxide levels to rise and large quantities of methane to be released. The advancing ice of the glacial period also destroys the bogs and the process therefore becomes self-limiting.

The conclusion from this and similar research is clear: life is not an innocent bystander to climate. On the contrary, living organisms are intimately involved in determining the processes that make the earth's climate what it is by generating and absorbing greenhouse gases; mediating the interchange of gases between rocks and soil, so enhancing weathering; dramatically changing the albedo of the earth's surface; and, not least, playing a key role in the hydrological cycles that shift energy around the globe through rainfall. If climate is indeed life-driven, the future climate of the earth will be determined as much by what happens to the earth's ecosystems as by future and past emissions of greenhouse and other gases. For it is the integrity of the earth's ecosystems that will largely determine the extent to which those greenhouse gases accumulate.

In that respect, the IPCC assessment that business can continue as usual in agriculture is doubly worrying. For while climate has a distinct effect on crops and where they can be grown, the reverse is also true with farming altering vegetation patterns and consequently the interchange of energy at the earth's surface. Current agricultural practices, by degrading soils and reducing forest cover, are not only contributing to the build-up of greenhouse gases but are also disrupting the ability of climate to recover from the perturbations caused by greenhouse gas emissions. In particular, land degradation, especially in the drylands, is likely to exacerbate the change in rainfall patterns that will result from a decline in marine stratus clouds and the change in ocean currents, not least in so-called El Niño events. Such events occur when the upwelling ocean currents from Antarctica along the western seaboard of South America get suppressed by warm equatorial waters flowing eastward across the Pacific ocean. The result is savage drought from South-East Asia all the way to South Africa, whilst the South-

Climate Change and Food Production

In its latest assessment, the Intergovernmental Panel on Climate Change (IPCC) acknowledges that climate change will have major, but varying, impacts on agriculture worldwide. It concludes, nonetheless, that, overall, food production will not be jeopardized.

Key to that conclusion is the assumption that elevated carbon dioxide levels will stimulate plant growth. Carbon dioxide is vital for photosynthesis — the process through which plants manufacture carbohydrates. IPCC expects a doubling of carbon dioxide to increase the rate of photosynthesis by 30 to 100 per cent, depending on the availability of nutrients and water.

But not all plants will benefit to the same extent. The difference depends on the pathways through which they photosynthesize sunlight. Plant species with a C-3 photosynthetic pathway (so called because the first product in their biochemical sequence of reactions has three carbon atoms) do well with higher levels of carbon dioxide in the atmosphere; those with a C-4 pathway less so. Key examples of C-3 plants are rye grasses and common grains, such as wheat, and pulses. C-4 plants include maize, sugarcane, prairie grasses, tropical grasses and millet.

Of the 86 plants that contribute 90 per cent of per capita food supplies worldwide, 80 of them are C-3 plants. Not only are yields of these crops likely to increase, argues the IPCC, but their growing season will be extended in many areas of the mid-latitudes. Models indicate, for example, that the boreal zone will be pushed polewards by a further 1,000 kilometres. It will also be possible to grow crops at higher altitudes.

The impacts of climate change, however, will vary enormously. Higher overall temperatures, for example, may make maize unviable at the limits of its range, for instance at the southern edge of the US Corn Belt; the same may be true of wheat grown in northern India. Other regions, however, will undoubtedly gain from global warming. Iceland, for example, may find itself able to support more livestock on a more plentiful growth of pasture.

Worryingly, the IPCC admits that the uncertainties surrounding

Robert Loxston

climate change are so huge that "it is not possible to distinguish reliably and precisely those areas that will benefit and those that will lose." Moreover, its optimistic conclusions as to future food supply take no account whatsoever of the likely impacts of pest, disease and a range of other factors.

A principle concern is that warmer climates will enable many insect pests to increase their populations by producing an extra generation each year or by expanding their geographical range. The European corn borer, for example, is a major pest of maize, and when the climate is suitable can produce as many as four generations a year. Experiments suggest that a 1°C temperature rise will result in the corn borer extending its range northwards by as much as 500 kilometres. Locust swarms may become common in southern Europe. Meanwhile, experiments in Japan on a range of other insects suggest that a 3°C temperature rise would see a major expansion in the range of tobacco cut-worm, southern green stink bug, rice stink bug, lima-bean pod borer, soyabean stem gall, rice weevil and soyabean pod borer. The range of the rice leaf beetle and rice leaf miner, however, would decrease. Animal diseases, such as African swine fever, are also likely to "jump" countries in a warmer world and may begin breaking out as far afield as North America.

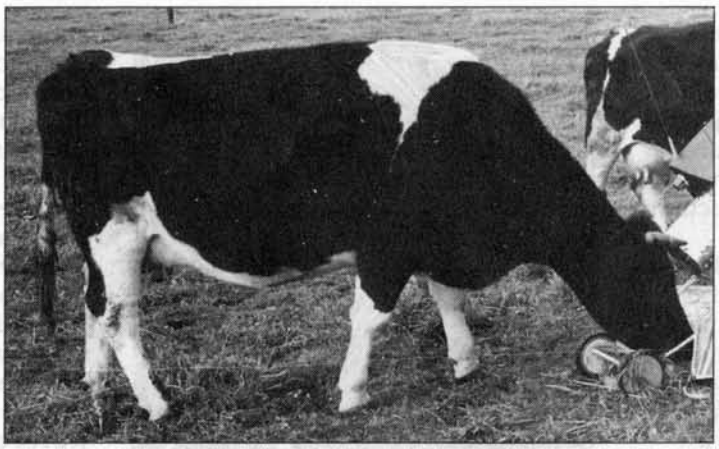
Fungal and bacteria pests in plants will also be affected by climate change, as will the ability of plants to resist them. Mild winters, for example, encourage outbreaks of fungal diseases such as powdery mildew and strip rust in cereals, whilst warm, humid conditions favour outbreaks of late potato blight. On the other hand, IPCC maintains that dry and hot summers generally reduce infestations of most fungal diseases because plant resistance is increased.

Enhanced levels of carbon dioxide will have a fertilizing effect on plants, including weeds, which currently cause 12 per cent of worldwide crop production to be lost. Changes in the variability of climate — with severe storms, heat waves and damaging frosts becoming the norm — may also undermine many biological forms of weed control since they are critically dependent on being able to synchronize the growth, development and reproduction of bio–control agents with the developmental cycle of target species. Chemical forms of control may also be affected. In some plants, for example, enhanced levels of carbon dioxide increase starch concentrations, rendering many herbicides ineffective.

Water availability will also be dramatically affected by climate change. Soil moisture is predicted to decrease in all the major food producing areas of the world. Several of the most vulnerable areas — North and Southern Africa, South-East Asia, Central America and eastern Brazil — are also those areas where malnutrition and hunger are currently widespread. The IPCC also warns that many of the world's soils are potentially vulnerable to soil degradation — primarily through the leaching of organic matter — as a result of climate change.

Although crop production may be extended into higher latitudes, sea-level rise and the inundation of low-lying coastal areas will offset the gains. The IPCC estimates that sea levels may rise by as much as 29 centimetres by the year 2030 and nearly a metre by the year 2090. Countries such as Bangladesh, Egypt, Thailand, China, parts of Denmark and the eastern seaboard of the United States, Indonesia and a large number of small-island-states such as the Maldives, will be most at risk from sea surges and coastal inundation. At least one quarter of agricultural land could be lost in Bangladesh. Worldwide, several hundred million people could be at risk.

Agriculture's Emissions of Greenhouse Gases



Moldvay/stern

Although agriculture's direct contribution to greenhouse gas emissions is small compared to that of industry, it is nonetheless significant. It is largely a result of intensification in agriculture since the Second World War: fewer people working on the land has led to a far greater energy input in terms of fossil fuels and chemicals while livestock stocking rates have greatly increased. Between 1970 to 1989, according to the OECD, the absolute average energy consumption per hectare went up by nearly 40 per cent to 1,734 megajoules. Japan's agriculture consumes 46,400 megajoules per hectare, the highest energy intensity in the world. The processing and marketing of food also plays an increasingly powerful role in global warming. In the United States, the average length of journey of processed food is some 3,000 kilometres. Worldwide, agriculture is responsible for approximately one quarter of anthropogenic carbon dioxide emissions, nearly 60 per cent of methane emissions and up to 80 per cent of nitrous oxide emissions. At least 40 million tonnes of methane a year come from biomass burning, including the destruction of tropical forests. In Britain, cattle on an average-sized 80 hectare dairy farm emit some 20 tonnes of methane a year. Heavy inputs of artificial fertilizers also add considerably to the levels of nitrous oxide — some 150 times more potent than carbon dioxide as a greenhouse gas — in the atmosphere. In The Netherlands, as much as 580 kilogrammes per hectare of nitrogen (in the form of nitrates or ammonium salts) are applied every year to farmland as fertilizer. At least ten per cent of this evaporates directly into the atmosphere. In areas of northern Europe where fertilizer use is heavy, the fall-out of nitrogenous compounds from the atmosphere has increased 20-fold or more since the Second World War.

Western United States suffers torrential rain. El Niño events used to occur approximately once every seven to ten years. Since the mid-1980s, however, one El Niño has followed hard on the heels of another.

Agriculture and Land Clearance

Most assessments of agriculture's contribution to climate change focus on the emissions caused by production processes (*see* Box, p.294). The principal impact of modern agriculture on climate, however, lies in the degradation caused directly or indirectly to land. In the North, spurred on by subsidies and squeezed by prices, farmers have been encouraged to bring as much land as possible under the plough and to adopt more and more intensive systems of production. In Europe and the US, there has seen a spate of government programmes since the Second World War to expand the numbers and output of livestock and the acreage under cereals and other crops. Farmers have been subsidized to drain wetlands, remove hedgerows and woodlands, and to bring marginal lands into production. In the US, more than 870,000 square kilometres of wetland (more than half the wetlands that existed 500 years ago) have been lost, 87 per cent of them converted to agriculture. Rangelands which once covered the vast expanse of the North American Great Plains and supported 60 million bison have also been converted into farmland on a massive scale, the majority being ploughed up and planted to cereal monocultures. In Florida, thousands of hectares of the Everglades have been drained since the 1920s, transforming the swamp into some of the richest agricultural land in the US.

Under the tutelage of the International Monetary Fund and the World Bank, governments in the South, too, have sought to increase the amount of land under production, primarily in order to earn the foreign exchange that will (supposedly) enable them to service their debts and achieve export-led growth. Rather than address the skewed patterns of land distribution that have resulted from such development strategies — with the best land used by richer farmers to grow export crops — many governments have encouraged the landless to open up marginal lands, particularly forests. In the Philippines, the island of Negros — once a carpet of forests — is now little more than a vast sugar estate. Meanwhile, those who previously farmed the land have been forced to clear the upland forests, which are currently being lost at the rate of more than 20,000 hectares a year.[8]

Land Clearance and Climate Change

The conversion of forests, rangelands and wetlands to agriculture — and in particular to monocultures — has major implications for climate. When wetlands are drained, for example, soils become rapidly oxidized, leading to emissions of greenhouse gases. Equally important, soluble sulphides (pyrites) in soils become oxidized to sulphuric acid. If the soils are rich in pyrites, soil acidity can rise catastrophically over a few decades, becoming many times more acid than vinegar. Not only does farming become impossible but any toxic chemicals used before farming had to be abandoned will become soluble and flush off into the groundwater. The albedo of the ground will also change as the soil becomes desiccated, leading to increased warming and further drying out.

Similarly, the loss of forests to agriculture (and other uses), particularly in the arid areas of the tropics, brings subtle changes in the absorption of energy and in wind currents that could lead to a substantial reduction in

rainfall. The movement of the moisture and the roughness of the land surface when trees are present lead to convection movements in the atmosphere that enhance rainfall. Tree cover accelerates the movement of water from the soil to the atmosphere and back again, thus keeping the cycle replenished. Experiments with models to mimic such convection processes suggest that rainfall would diminish by as much as one third were the trees to be totally eradicated.

In the Sahel — those arid lands between the Sahara desert and the lush rainforest of equatorial Africa — rainfall has diminished on average by 15 per cent since the mid-1960s, from 1,200 millimetres per annum to just over 800 millimetres. The decline in rainfall has coincided with several years of drought, especially those of 1972 and 1973 as well as 1983 and 1984, in which thousands of livestock and humans perished. Robert Mann, who has worked for many years as an agronomist in the Gambia and other countries of Africa, points out that, by 1984, the Sahelian shortfall in rain had lasted 17 years and showed few signs of abating, indicating a substantial change in climate.[9]

Mann is convinced that the drying out of West Africa is a consequence of the massive deforestation — primarily the result of commercial logging and the subsequent use of forest land for agriculture — that has occurred at an accelerating speed over the past century. He points out that, because the air has become drier, midday temperatures that used to peak at 35°C are now rising to as much as 65°C. The net result of the increased temperature is an even more rapid drying-out of soil and the lower atmosphere, thus setting in motion desertification, the process by which drylands become degraded through a vicious cycle of vegetation-loss and drying out. The greater contrast between the temperatures of day and night brings about stronger wind currents so that the vegetation-sparse, dried-out soil begins to get swept upwards into the atmosphere as dust.

Equity and Emission Controls

In 1990, the Intergovernmental Panel on Climate Change (IPCC) warned that cuts in greenhouse gas emissions of between 60 per cent and 80 per cent are required immediately if greenhouse gas concentrations are to be stabilized and global warming averted.

Since then, governments have been engaged in a heated debate over how to achieve such cuts — and whether or not they are really necessary. Some advocate action now to prevent future change; others hold that the cheapest option is to do nothing now and pay later in the hope that it will not prove too expensive.

Many economists argue that the costs of climate change will not amount to more than 1.5 to 2 per cent of annual Gross World Product (GWP) by the year 2050 (when IPCC suggests that atmospheric carbon dioxide will have doubled) — and that action to curb emissions is therefore unjustified on economic grounds. Others argue that the damage range for that year is more likely to be between 12 and 130 per cent of GWP and between $50 and $600 trillion accumulated cost between the years 1990 and 2050.

A particular problem with any assessment of the cost to society at large from an impact such as climate change is that the perpetrators are not necessarily the same people as the victims. Future action therefore depends on international agreements bringing some notion of equity to bear on the argument, so that those who cause climate change but escape or even benefit from its impact should help meet the costs to those who will suffer.

The problem is proving a thorny one to resolve. To ensure that all countries participate in contraction, future emission limits will have to be distributed in a sufficiently equitable manner. The World Bank and other free market advocates favour future distribution in proportion to a country's GDP — in effect rewarding polluters for their impact on climate change as the correlation between emissions and GDP is nearly absolute. The opposite approach is to distribute emissions in proportion to a country's population — the equal per capita approach. The difficulty here is the immediate scale of redistribution and the effective bankrupting of industrial countries.

Michael Grubb at the Royal Institute of International Affairs in London argues for an individual quota of one tonne of carbon per year. Since the annual emissions of carbon from fossil fuels amount to some six billion tonnes of carbon, Grubb's quota system, if applied to today's world population, would keep emissions close to where they are now. An energy profligate nation such as the United States would pay for its profligacy, or be induced to curb its energy use and make some of its quota available elsewhere.

One criticism of Grubb's plan is that it would not reduce emissions sufficiently to avoid global warming. A more radical proposal has been put forward by the UK-based Global Commons Institute (GCI), which has done more than any other group to put the issue of equity on the climate agenda.

GCI proposes a programme of "contraction and convergence" which has gained significant inter–national support. This requires global contraction of emissions by at least 60 per cent against 1990 levels within a specified time-frame and suggests that the level of cuts should be reviewed continuously thereafter as evidence emerges of climate change-related dangers and damages. The programme also requires that current unequal per capita levels of emissions are policy-driven to convergence at an equal level throughout the world within a related, but not necessarily identical, time-frame.

GCI argues that such a way of allocating future international entitlements to emit greenhouse gases provides the best likelihood that all nations will come to an agreement and would decisively restrain and resolve both the unsustainability of present patterns of emissions and their polarization across the globe.

GCI also recommends that UN medium population growth projections inform these accounts until the agreed date of convergence. After this date, any future population growth should not affect the allocation of emissions between nations.

Although the debate on equity is only just beginning, few now doubt that equity, both within countries and between them, must be the starting point for any agreement to apportion cuts in greenhouse emissions.

Large (A3) colour all-country graphics of "Contraction and Convergence" available from: GCI, 42 Windsor Rd, London NW2 5DS, UK. Tel: 0181-451 0778; Fax: 0181-830 2366; e-mail: <saveforests@gn.apc.org>; website: http://gn.apc.org/gci

Such degradation is already resulting in huge quantities of dust being released into the atmosphere. High altitude dust alters the energy budget of the atmosphere, both by reflecting sunlight back into space and acting as a greenhouse blanket. Climatologists are still uncertain which of the two effects is likely to predominate. The quantities of Sahelian dust in the atmosphere have increased significantly over the past few decades. In 1966, meteorologists based more than 4,700 kilometres across the Atlantic in Barbados measured six microgrammes per cubic metre of African dust; just seven years later in 1973, the quantities had increased to 24 microgrammes per cubic metre. According to official United Nations figures, desertification is advancing at a rate of 60,000 square kilometres per year out of the total dryland area of 50 million square kilometres, of which one-third is in Africa.

Hydrological Cycles

The disruption of hydrological cycles through deforestation and other forms of land degradation ultimately has climatic consequences that reach far beyond the immediate region. Water is the main carrier of energy in the atmosphere. Over a matter of a few degrees Celsius, water can pass from ice to vapour or from ice or vapour to liquid and vice versa with the release or absorption of extraordinary quantities of energy. Clouds, such as towering cumulo-nimbus, that rise quickly through the lower atmosphere, take energy from the earth's surface and distribute it throughout the atmospheric column much quicker than the rate at which warming is brought about by radiative heating from the sun. Water in its different phases — clouds, sea and ice — also accounts for 94 per cent of total albedo, some absorbing, some reflecting.

Farmers' Increased Vulnerability to Climate Change

Farmers the world over have always had to contend with the vagaries of climate. In doing so, they have devised numerous strategies to hedge against the risks the elements pose to their crops, the main one being to plant a wide and diverse range of varieties. Should one crop fail, others will see that the household is fed. Throughout the tropics, for example, traditional agroforestry systems commonly contain well over 100 annual and perennial plant species per field.

North and South, the vulnerability of farmers to climatic changes has been greatly exacerbated by the industrialization of agriculture and the socio-political changes that have accompanied the increasing globalization of economy and society. The introduction of monocultures and Green Revolution crops, for instance, has drastically reduced the genetic diversity used in agriculture — and hence increased the risk of crop failure due to even small changes in climate or climatically-induced pest infestations. In the early 1980s, 67 per cent of all the wheat sown in Bangladesh and 30 per cent of Indian wheat consisted of just one variety of wheat — Sonalike. Genetic engineering is likely to restrict diversity still further, with single varieties tailored to embody a whole range of characteristics, including responsiveness to fertilizers and resistance to pathogens.

The social and economic impacts of the Green Revolution have added to the insecurity of poorer farmers, making them more vulnerable to the disruption of climate change. Low commodity prices and the high cost of farm inputs have thrown many into debt, driving numerous households off the land and increasing the concentration of land ownership. Many landless peasants now have little option but to move into marginal areas, such as forests, where poor soils and a fragile environment leave little room for manoeuvre in the event of even small changes in climate.

Third World debt has added to the pressures as Southern governments seek to reduce public expenditure by cutting subsidies to farmers as part of IMF-imposed loan conditions. Cutbacks in irrigation maintenance and other infrastructure have undermined the viability of many land holdings.

Operating on a financial and ecological knife-edge, farmers in both North and South are therefore increasingly vulnerable to even slight changes in climate. As Kirsten Appendini and Diana Liverman report for rainfed areas of Mexico, where maize production is particularly sensitive to any delay in the start of the summer rainy season:

> "Even slightly below average rainfall can place crops at risk. On average, more than 90 per cent of losses in Mexican agriculture are from drought. In 1990, with favourable weather, about seven per cent of the crop area that was planted was lost to natural hazards. In 1979, with less favourable weather, drought losses alone devastated 19 per cent of the area planted. A large region of central and northern Mexico lost more than 50 per cent of the area planted."

The problem has been compounded in recent years by the increasing integration of Mexico into the global economy. In particular, farmers have been encouraged to switch from growing rainfed subsistence crops to growing irrigated crops — such as fruit, vegetables and feedgrains — for export. As the crop mix has become more water-demanding, rainfall deficits have become more critical.

Economic models suggests that the North American Free Trade Agreement and other moves to liberalize Mexican agriculture are likely to exacerbate that trend, as small farmers, unable to compete with imports of foreign grains, switch to horticulture to maintain their livelihoods.

The IPCC argues that the adaption farmers will have to make to climate change and instability will not "add significantly" to the disruption and changes they will have to make anyway because of "future changes in economic conditions, population, technology and resource availabilities". Those "future changes", however, are making adaption to climate change an impossibility for millions of farmers.

Source: Appendini, K. and Liverman, D., "Agricultural policy, climate change and food security in Mexico", *Food Policy*, 19 (2), 1994, pp.149-164.

The albedo of clouds taken as a whole overrides the greenhouse effect of water vapour and gives a net cooling of 13 watts per square metre, compared with an average total received energy of 240 watts per square metre.

Changes in land use, in particular the once-and-for-all destruction of forests in the tropics and their replacement with cattle-ranching or rice paddies, are now threatening to disrupt global hydrological cycles that transfer water — and hence energy — around the planet. Forest vegetation creates a "rougher" surface and is essentially darker in terms of light absorption compared with grass. It also transpires at a far greater rate, pushing back into the atmosphere between half and three-quarters of the rain that falls over it — amounting, in the case of the Amazon rainforest, to some 12 million million tonnes of water.

Clear the forest and not only is the pattern of precipitation altered, bringing about a successive drying-out, but the energy transfer between the soil and the atmosphere is also disrupted. Indeed, the bank of cumulonimbus clouds that form over the forest through the pumping of water not only affects albedo by reflecting sunlight but also carries phenomenal quantities of energy in the form of water that is translocated to higher latitudes. The Amazon Basin, with its forest intact, actually sends away more than 40 times all the energy currently consumed in all human activities across the globe. Much of that energy falls as rain over North America and Europe, where its warmth is imparted to the atmosphere. The Amazonian rainforest, as a consequence of its size, is therefore an integral part of a giant solar heat-pump that moderates the climate worldwide, keeping the tropics cool while transporting heat to colder climes.

Runaway Feedbacks

A theory of climate which fails to account properly for life being embedded in planetary processes is incomplete at best. This failure of General Circulation Models is not just a carping criticism: the danger is that global warming will unleash an avalanche of effects that will reinforce the warming, sending surface temperatures soaring. The situation at the end of the next century could be far worse than that projected in the present GCMs.

Lee Kump, a climatologist at the University of Pennsylvania, and James Lovelock set up a model specifically to look at the respective contributions of life in the oceans and on land to the stabilizing of global temperatures.[10] The contribution from the oceans was through the formation of marine stratus clouds as a result of surface-dwelling *coccolith* algae which generate dimethylsulphide (itself the breakdown product of a metabolite used in the production of an osmolyte to protect against salt stress). Just above the surface of the sea, the dimethylsulphide oxidizes to sulphur dioxide which acts as cloud condensation nuclei. Gaia theory suggests that the plankton help regulate temperature by generating more or less clouds.

Such regulation depends on a good supply of nutrients. If the temperature drops close to freezing, the plankton can barely grow and few clouds will be produced (hence the drying-out over land associated with an Ice Age). On the other hand, a cloudless sea absorbs heats and warms up, thereby encouraging plankton growth which leads to the generation of more clouds. With more clouds, the surface temperature comes down. That system works only within well-defined temperature limits, the reason being that an ocean whose surface waters are above 12°C tends to become layered, which itself prevents upwellings and the bringing of nutrients to the surface. The system breaks down when excessive ocean warming causes the warm layer (which divides surface waters from deeper waters) to spread to higher and higher latitudes from the tropics.

Meanwhile, the contribution from land to the stabilizing of global temperatures is from vegetation drawing down carbon dioxide. As temperatures increase, so plants suffer from a drying out of soils and from water stress. Their efficiency in taking carbon dioxide out of the atmosphere is thereby significantly reduced.

Cameroon rainforest. Destruction of tropical forests and their replacement with cattle-ranches or rice paddies threaten to disrupt the global hydrological cycles which transfer water and energy around the planet. Of particular concern is loss of the huge Amazonian rainforest which moderates climate worldwide, keeping the tropics cool while transporting heat to colder climes.

In both land and oceans, rising temperatures take their toll on vegetative growth. Since living organisms are critical to the uptake of greenhouse gases, the fall in growth will affect their ability to regulate such gases and so to counter global warming. Kump and Lovelock conclude that ocean warming is now proceeding rapidly, especially in the tropics and lower latitudes, with the result that plankton activity is declining. The oceans are therefore losing their ability to regulate climate. Terrestrial vegetation will lose its ability to regulate climate once the average surface temperature reaches around 18°C — IPCC estimates that a century from now, the earth will have temperatures close to that critical point.

Somewhat worrying in that respect is the recent evidence that the Gulf Stream is not the stable, unchanging flow, like Old Man River, that we once believed it to be. A flow of water equivalent to some hundred Amazon rivers, the Gulf Stream carries the energy equivalent of more than one thousand million million watts of heat from the tropics to the high latitudes, sweeping past Britain and penetrating up to the north of Scandinavia. As a result, the waters moving northwards are on average 8°C warmer than those that have sunk to the ocean floor and are moving southwards. The amount of energy flowing from the tropics to the mid-latitudes in the oceanic waters may amount to as much as one quarter of all the energy being transferred across the planet. Recent

studies by physicist Vittorio Canuto and others at NASA's Goddard Space Institute in New York indicate that either a small increase in the volume of fresh water flowing into the Northern Atlantic (from melting glaciers, for instance) or a decline in the flow of salt water into the Atlantic from the Mediterranean (because of falling sea levels in the Mediterranean due to increased evaporation) would be enough to upset the Gulf Stream and possibly cause it to come shuddering to a halt far to the south from its present course up into the Arctic Circle.

The flow of the Gulf Stream depends on sufficient ice forming in the Arctic Circle so as to make surface waters dense and salty. These then sink to the bottom of the ocean and flow back towards the Equator. A warming up, which brings a greater flow of freshwater to the Northern waters, dilutes the salt waters to such an extent that the waters may fail to sink.

Particularly disturbing is the correlation between such upsets and the effective greenhouse gas concentrations in the lower atmosphere. Should the concentrations rise to four times their pre-industrial levels, a likely occurrence if current trends continue, then the Gulf Stream could permanently halt in its tracks because of the influx of more freshwater from melting glaciers. Also, a warmer autumn and winter will cause less ice to form; less ice means a lower albedo and more heat absorption by the ocean. Such effects are self-reinforcing and runaway. Were the Gulf Stream to fail, the transport of heat would fail and the temperature would drop dramatically. As a result, Britain would find itself in a see-saw between bitter chills and global warming, swings which would play havoc with any agricultural system.

Conclusion

The prospects are grim. If farmers can no longer count on the weather from one year being a rough guide to the weather for the next, how will they know which are the best crops to plant? How will they be able to tell how much water they need? Or when they should be planted and harvested? And what of crops that usually take a long time to mature? If a Scottish farmer plants an apple tree today, how can he or she be certain that it will not mature in a climate where only the olive tree bears fruit?

Past periods of abrupt swings in climate point to the likely human consequences of such instability. In Sweden and Scotland, for example, during a sudden dip in temperature that followed the warm Medieval period, a succession of failed harvests reduced much of the population to such misery that they resorted to baking bread from the bark of trees. Thousands died. Storms, especially in the lowlands flanking the North Sea, were ferocious and scores of towns and villages were destroyed overnight. In just two floods, in the years 1240 and 1362, 60 parishes in the province of Schleswig were swallowed by the sea, with the loss of half the agricultural land. One-third of a million people drowned in one sea flood that struck the Dutch and German coasts. On the east coast of Scotland in Aberdeenshire, all that can now be seen of the medieval settlement of Forvie is a 30-metre-high sand dune that covered the town during a southerly storm in August 1413.

Such disasters are likely to be minor, however, compared to what lies in store if the ecosystems on which the earth's current climate depends continue to be destroyed. In that respect, the future direction of agriculture is critical. Instead of putting efforts into transgenic crops, a major recommendation of many agronomists, we should be looking to evolve ways of living that enable food to be produced without destroying soil fertility and the integrity of the immediate and wider environment. In that respect, ensuring food security in a time of climate change — and reducing climatic instability — is less a matter of technology than of politics.

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Farming the City

The Potential of Urban Agriculture

Tara Garnett

By the year 2000, the majority of the world's population will live in cities. In the South, urban agriculture is a thriving response by poorer people to the problems of obtaining food in an era of structural adjustment and increasing poverty. In the North, the imperative to grow one's own food is less immediate, but the arguments in favour of urban agriculture on the grounds of community and health regeneration are compelling, particularly for those on low incomes. Britain is a case in point.

"And the Lord God planted a garden eastward in Eden; and there he put the man whom he had formed. And out of the ground made the Lord God to grow every tree that is pleasant to the sight, and good for food."
Genesis 2, *8*

"And I, John, saw the holy city, new Jerusalem, coming down from God out of heaven, prepared as a bride adorned for her husband . . . Having the glory of God: and her light was like unto a stone most precious."
Revelations 21, *2 & 11*

The garden and the city are at the heart of many utopias. They can address many fundamental human needs, particularly for food and shelter. Together, they symbolize the contradictory desire to be part of nature while simultaneously out-doing it: in the garden, we are one of God's or Nature's creations; in the city, we are the creators.

Throughout the ages, the "natural" state represented by the garden and the "civil" society have garnered their respective advocates and adherents. The ancient Greek poet Theocritus, for instance, extolled the joys of the brook-burbling, shepherd-piping landscape way back in the fourth century BC — the dairy industry in Britain is still at it today in its advertising campaigns. Cities, meanwhile, are usually portrayed as places of opportunity and (wicked) excitement where art, innovation and ideas flourish while social constraints and conventions are relaxed. As an old German proverb says, *Stadtluft macht frei* — "City air makes you free".[1]

The realities, however, of garden and city are somewhat different. By the year 2000, the majority of the world's people will live in cities.[2] According to the United Nations, there will be around 45 cities with populations of five million or more by the turn of the century — 34 of these conurbations in the South.[3] In physical terms, cities consume more than they produce and generate more waste than they can deal with. Although they cover only two per cent of the earth's surface, they use up to 75 per cent of the world's resources. London's total social, environmental and economic impact upon world resources is felt upon nearly 20 million hectares, about 125 times its surface area. Home to only 12 per cent of Britain's population, London consumes 2.4 million tonnes of food a year[4] and requires the equivalent of the country's entire productive land area to sustain itself — the land actually used to meet the city's needs is spread all over the world.

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Life in the country, meanwhile, is hardly a bucolic idyll, if it ever was. In many places the world over, the "natural" environment is being destroyed by a combination of agribusiness, heritage or theme-park tourism, war and famine. Rural unemployment and underemployment is high, as is the fragmentation of rural communities. In Britain, all these factors, combined with the recent BSE "mad cow disease" crisis, have led to increased mental health problems and suicides in rural areas.[5]

Given this disjuncture between ideal and reality, some utopians, poets and visionaries — not to mention town-planners — have proposed a reconciliation of the garden with the city, a productive ideal which is at once artless and artificial, beautiful and useful, food and shelter. The concept was given its fullest expression at the turn of this century by British planner Ebeneezer Howard, founder and originator of the garden city.[6] Howard lamented the "unholy, unnatural separation of society and nature" and saw in their union the possibility of "a new hope, a new life, a new civilization".[7]

In the South, urban agriculture is a well-established survival response to what has become a structurally-adjusted urban wilderness for many people.[8] In the North, the imperative to grow one's own food seems less immediate, but the arguments in favour of urban agriculture on the grounds of community and health regeneration are compelling, particularly for those living on low incomes.[9]

Indeed, urban agriculture could make a real contribution to the process of sustainable development — with the emphasis on "could". In some parts of the world, the movement is strong and vibrant, in others, such as Britain, many political, economic and cultural barriers have still to be overcome — but the potential and scope are there.

Land Regeneration

Land or soil is the first requisite to grow food, and contrary to popular belief, there is a fair amount of unused land available in urban areas. The Council for the Protection of Rural England suggests that five per cent of urban land in the UK lies vacant.[10]

Within the urban space, one of the most obvious examples of land specifically intended for food production is an allotment. There are around half a million allotments in Britain today (*see* Box, p.301). They are still legally protected from development (albeit by legislation which is anachronistic, complex and in need of reform).[11] In some areas, allotment sites have ten-year waiting lists and are a hub of community activity. In others, the paucity of allotment provision and promotion has resulted in underuse. Many are poorly maintained by impoverished local authorities. Some are under threat from developers, often for golf courses or luxury housing, and the ensuing uncertainty deters would-be gardeners who know that maintaining soil fertility and nurturing plants can take several seasons. But threats to allotment sites have also been a galvanizing force for communities to come together to protect them.

The promotion of food growing in the underused areas of local parks could inject life into these undermaintained public amenities. Far from being a novel idea, areas of park land were cultivated during the First and Second World Wars. The current decline is mainly due to a lack of funding — in most cities, expenditure on maintaining parks and open space has either levelled off or is decreasing. The park attendant, for instance, is now largely a thing of the past. Linked to this decline are growing fears about crime and the lack of personal safety in parks.[12] Half the funding that is available is spent on the provision of sports pitches — a facility which, although important, is used by just six per cent of the British population. Only 30 per cent of local authorities have any kind of management plan for their parks, despite the fact that 70 per cent of respondents to a Department of Environment survey put parks, gardens and open spaces top of a list of London's attractions.[13] The government has, however, recognized that parks are a significant social and environmental resource[14] and more funding, via the Millennium Commission for instance, is being made available.

Local authorities could also help promote biodiversity in parks through organic-only food-growing policies and by promoting the use of non-commercial crop varieties, many of which will die out unless they are grown. Fruit trees could also be grown in parks, as they are in Stockholm, Prague and Bangalore, where 25 per cent of trees in the city's parks are fruit-bearing.[15]

The land around housing estates is another area where food could be grown. The use of public land surrounding blocks of flats is common in Eastern European countries,[16] but is virtually unheard of in Britain except for one or two housing estates which are beginning to grow food. Housing of a density of 100 people per hectare, 40-50 dwellings, can be fully compatible with a range of facilities such as allotments and play areas.[17] Some private gardens and school grounds are being used to grow food.

One concern about the suitability of urban land for food growing is its potential contamination due to previous activities on the site such as metal works, tanneries and gas works, the legacy of Victorian industrialization. The 1995 Environment Act requires local authorities to survey land for contamination,[18] but does not provide the necessary funds to do so nor for remediation. A potential gardener does not know whether land is contaminated without researching its past uses or conducting expensive soil tests. Lead is the most common contaminant and the main risk to urban food growers (although the main source of lead pollution in cities is car exhausts).[19]

Some food growers avoid the problem of contamination by bringing in soil or compost and cultivating in raised beds. Many people, however, are deterred from the whole enterprise. For food growing to make a real contribution to urban life, comprehensive land remediation is vital. The expensive investment will pay off as local food growing and ancillary enterprises create wealth in the area. If the land cannot be cleaned-up immediately, a non-food crop such as hemp, which has a variety of uses (cloth and paper-making, for instance), could be grown. As this crop reduces the toxicity of the soil, food could be grown on the site a few seasons later.[20]

Diggers and Allotments

The birth of the allotment movement in Britain has political origins. In 1649, a group of people, led by Gerard Winstanley and subsequently known as the Diggers, invaded land at St George's Hill in Surrey to protest against the enclosure by landlords of common land that had been free to all local communities for grazing and cultivation. Allotments — small plots of land in urban areas rented out cheaply to those wishing to grow their own food — were originally mooted by politicians and other public figures to compensate for this loss of common land.

The suggestion was controversial: some saw allotments as generous assistance to the displaced poor; others felt that granting small allotments in lieu of common rights was fraudulent as it was "impossible to compensate for the loss" of those "ancient privileges belonging to the humble British peasant". John Stuart Mill argued that allotments "were a contrivance to compensate the labourer for the insufficiency of his wages . . . a method of making the poor grow their own poor rate".

The first allotments were rural smallholdings held by agricultural labourers to compensate them for this loss. Mandatory provision of such smallholdings, each no larger than a quarter of an acre, was included in the General Inclosure Act of 1845. Legal obligation, however, did not translate into practice: an 1869 estimate calculated that of 614,800 acres of land enclosed since 1845, just 2,223 of them had been assigned to the poor.

As the landless poor, thrown off the land by enclosure, migrated for work to the rapidly-industrializing cities in the eighteenth and nineteenth centuries, so the demand arose in urban areas for plots of land where people could grow food.

In 1908, the Small Holdings and Allotments Act made it mandatory for local authorities to provide and rent out allotments. Just ten years later in 1918, there were between 1.3 million and 1.5 million allotments in Britain which together produced some two million tonnes of vegetables — even though the government considered food growing to be bad for morale and did not at first promote it.

Widespread unemployment in the late 1920s and 1930s continued the interest in food growing. Philanthropic schemes sprang up to supply fertilizers, seeds and other necessities and inputs to the unemployed. When the Second World War broke out in 1939, the government was quick to promote allotment gardening in its "Dig for Victory" campaign. Local authorities took over parks, wastelands and garden lawns. Exhibitions were organized and demonstration plots set up. Millions of leaflets on vegetable growing were distributed and radio talks broadcast. Prizes were offered for the best compost heap and vegetables; subsidies for fertilizers were provided. People from the United States, Canada, New Zealand and Australia sent in seed supplies.

During the War, more than half the manual workers in the country kept an allotment or garden. Domestic hen keepers produced about a quarter of the country's eggs; pig keeping was popular. In 1944, some 300,000 acres of allotments and gardens were under crops, producing 1.3 million tons of food — ten per cent of all the food produced in Britain and around half of the country's fruit and vegetable needs.

After the War, food-growing land was lost to housing, schools, hospitals and industries. The impetus to grow food waned, unable to shake off its associations with wartime deprivation, while advances in living standards for many people meant that there was less of an incentive to grow one's own.

A 1969 government report, completed after five years study, emphasized that legislation concerning allotments was vague, obsolete and incomprehensible; it has still to be revised. During the 1970s, increased ecological and health awareness and the spread of vacant sites as a result of rocketing land prices, led to renewed interest in food growing. Waiting lists for allotments shot up.

This resurgence of interest in food growing has continued in the 1990s. No longer regarded by many as old-fashioned or a patronizing gesture to the poor, urban food growing has realigned itself with the old Digger philosophy as a means of empowerment.

Sources: Crouch, D. and Ward, C., *The Allotment: Its Landscape and Culture*, Mushroom Bookshop, 10-12 Heathcote St, Nottingham NG1 3AA, 1994; Riley, P., *Economic Growth: The Allotments Campaign Guide*, Friends of the Earth, 1979.

Environmental Regeneration

Food growing could contribute towards the sustainability of cities in several ways. It could reduce the amount of food-related transport which at present accounts for one quarter of all journeys in Britain and some 12 per cent of Britain's fuel consumption.[21] In 1993, the country exported fruit and vegetables worth £390 million and imported £3,459 million's worth — much of it transported by road or air, exacting a heavy environmental toll in terms of fossil fuel use and pollution. Wildlife habitats are damaged through road building.[22] Locally-produced food reduces the need to travel, both to distribute food and to buy it, while local employment in food production reduces the need to travel to work.

Urban agriculture could also reduce waste. British households produce 20 million tonnes of waste a year of which half could be recycled — and of which only five per cent is.[23] Discarded food and its packaging accounts for much of this waste: over 150 million tonnes of plastic, paper and glass are used each year for packaging food.[24] Some packaging is merely cosmetic, but much is essential if the contents are to reach their destination safely. Because food grown and consumed locally does not need to travel far, protective packaging can be dispensed with. Food growers can (and do) reuse household waste — old carpet for mulch, offcuts of wood and glass for improvised greenhouses and, the obligatory allotment site installation, a bathtub for water collection.

Most significantly, urban agriculture could put organic waste to productive use. Accounting for 20 per cent of household waste in Britain — four million tonnes a year — organic waste becomes highly-polluting in landfills where it generates methane, one of the most destructive greenhouse gases.[25] It has also become more expensive for local authorities to dispose of since landfill taxes were introduced in October 1996.

When composted, organic waste — vegetable scraps, grass clippings, leaf mould and (for the committed) human urine and excrement — makes an excellent fertilizer. Currently, only 0.5 per cent of household waste is composted.[26] Centralized or community composting schemes could not only reduce the amount of household organic waste (and green waste from parks) that has to be disposed of, but could also be sold on to local gardeners or horticultural businesses to encourage local food production.[27]

Another role for urban agriculture is in conserving biodiversity. Surprisingly, the urban environment can often be richer in flora and fauna than rural farmland — beehives in cities, for instance, tend to produce more honey than those in the country because there are more trees and flowers in cities than most parts of the modern countryside.[28] Arrangements of organically-managed food growing plots and gardens could create green "corridors" to draw wildlife such as birds, small mammals and reptiles into the city — organic food growing systems encourage wildlife, since attracting natural predators is essential to control pests.

In addition, domestic gardeners often grow varieties of fruit and vegetables which are no longer commercially available and would otherwise die out. The St Ann's Allotment in Nottingham, for instance, one of the largest and oldest allotment sites in Britain, grows two varieties of apple local to the area, the Radford Beauty and the Nottingham Pippin.

GreenThumb Community Gardening Programme

GreenThumb began in 1978 in New York City with no budget and one part-time worker in response to the growing number of requests for permission to garden on city-owned property. The programme, funded by the New York Parks and Recreation department, is now the largest municipally-run community gardening project in the United States. It leases out over 1,000 plots (125 acres) free of charge to over 700 community gardening groups, and employs eight staff to work with them.

The community gardens produce around $100,000 of fruit and vegetables a year. The gardens often incorporate play and sitting areas, thereby providing a focus and site for neighbourhood activities. GreenThumb provides groups with tools and materials for fences, raised beds and picnic tables as well as trees, shrubs and seeds. In addition to running workshops in planting, design and construction, GreenThumb runs the following programmes:

- Land Reclamation Project, which annually treats 250 acres of land by seeding with grasses, clover and wildflowers;
- Urban Orchard Programme, under which nearly 2,000 apple, peach, plum, cherry and pear trees as well as thousands of grape vines and berries have been planted since 1984;
- Artists in the Gardens. Local artists and communities have worked together to install 17 sculptures and 10 murals in the last ten years;
- Education in the Gardens, under which gardening groups are provided with educational material and encouraged to invite school groups and local children into their gardens. Schools are also encouraged to establish their own gardens;
- Project ReSeed, a workshop series for teachers focusing on using gardens to teach urban environmental issues. The PlayScape Project is developing three demonstration play areas in existing gardens for neighbourhood children. These will enable staff to design a workshop and resource manual to help other gardens establish their own PlayScapes.

There is also an annual GreenThumb GrowTogether which brings together over 500 people to exchange information and to attend some of over 40 workshops on offer. GreenThumb also holds a yearly harvest fair with garden tours, competitions and workshops and issues newsletters, planning manuals and other publications.

Source: *Growing Food in Cities*, National Food Alliance and SAFE Alliance, 1996.

Economic Regeneration

In the South, urban agriculture is an important source of livelihood and survival for many households. In some cities, between one-fifth to one-third of families are engaged in agriculture, with as many as one third of these having no other source of income.[29] Tanzania's 1988 census found that urban agriculture was the second-largest employer in the Dar es Salaam district, involving one in five adults of working age in a population of about two million.[30] In the Nepali capital of Kathmandu, 37 per cent of food producers meet all their household vegetable needs and 11 per cent of their animal produce needs through their own efforts. In Hong Kong, vegetables sufficient to meet 45 per cent of local demand are produced on five to six per cent of the total land area.[31]

In Britain, the situation is very different. Although farming occupies some 76 per cent of the land, it employs a mere 2.2 per cent of the population. Being a nation of town and city dwellers — 89 per cent of the British population now live in urban areas on 7.7 per cent of the land[32] — many people have lost contact with the land and with the way food is produced. The number of urban dwellers making a living or even growing a significant amount of their own food in the city is minute.[33]

Urban agriculture could form the basis of a whole range of local industries — from horticultural enterprises to compost, seed and tools suppliers, from retail outlets to cafés and restaurants — and could reinvigorate street markets. It could generate jobs and skills-training in urban areas.

Urban agriculture could also stimulate the growth of an alternative urban economy, tapping into the small but growing number of cooperatives, local exchange trading schemes, credit unions and other non-profit making enterprises. Such alternatives are, in part, a response to increasing dissatisfaction with the formal economy and its generation of inequality.

Food growing could also challenge the prevalent work-leisure dichotomy. Leisure is increasingly not just the opposite of work but another commodity, a product of work. In 1995, consumers in Britain spent around £110 billion on leisure goods and services.[34] The ability to consume leisure is dependent on the ability to pay for it. The unemployed and underemployed are thus excluded not only from work and a livelihood but also from leisure — their time has no commodified value. In a society defined by the market economy, this exclusion can contribute to a vicious cycle of depression, low self-esteem and consequent unemployability. Food growing is a way of reclaiming control over time and of self-worth. The end product has value not only in the formal economy but in an absolute sense — it feeds people.

At a time when companies are driving down wages and policymakers are keen to dismantle the welfare state, concerns have been raised that the growth of informal self-help activities such as growing one's own food could be used to justify further erosion of safety nets and support for the poorest members of society. Similar concerns were raised when allotments were first introduced as compensation for the loss of common land — a case of taking a mile and bestowing an inch (*see* Box, p.301). Food growing might become the only barrier between the urban poor and starvation in a cost-cutting, post-welfare Britain, as it already is in many places of the South.But urban food growing threatens not so much the welfare state but a socially- and environmentally-unsustainable economic system. As one London gardener puts it, food growing is a sort of "benign terrorism digging away at global corporations and bureaucracies".[35] Urban food growing can be a way of reclaiming our right to land — and indeed remembering that we have this right.

Ashram Acres

Easter playscheme at Ashram Acres, a community organic garden in Birmingham which grows Asian, Caribbean and European vegetables, and keeps goats for milk and hens for eggs.

Some schools in Britain have dug up part of their tarmac playgrounds and planted vegetables. Core curriculum subjects such as maths, geography and history can be applied to gardening activities.

Some projects have reported that, as children and teachers begin to value their surroundings more, there is a noticeable decline in vandalism and an improvement in teacher and pupil morale.

Some schools are not only growing their food but learning to cook it as well, a practical form of health and nutritional education which counters a current decline in cooking skills.

These activities are mostly found in primary schools, rather than in secondary schools or universities. This reflects not only a greater flexibility in the primary school statutory timetable, but also highlighting a prevalent attitude that environmental education is fine for younger children, but not really relevant to the practical working life for which secondary and further education is meant to prepare its students.

Health Regeneration

Not only can food growing re-engage people with the land that produces food but it can also promote a more balanced attitude towards our bodies and our health. An estimated half of the British population are overweight or obese[36] while heart disease and strokes, the diseases of over-consumption, are major killers. Nearly one-third of men and over two-thirds of women cannot sustain a walk at a normal pace on a modest slope.[37] Meanwhile, a significant number of women deliberately starve themselves[38] courtesy of the UK's billion pound diet industry.[39] This feast-fast combination mirrors a farming

The Making of Modern Malnutrition

Food Poverty in Britain

"I'd say in a good week, we'd have about £30 for food, in a very good week. In a bad week, we'd have £20 — and that's for the four of us. On a particularly tough fortnight, we would eat one meal a day so that the kids could eat, because they don't understand the fact that food costs money, and if you haven't got the money, you can't buy the food."

Mother of two children

"I've always worked, so being on benefit was something new to me. It's something of a nightmare. All the time you are looking for the cheapest of brands. My diet has changed dramatically. Basically now I'm eating shite. I've put on three stone."

Woman who moved from decent wages to welfare

"There's poverty that you'd never believe. I've had children coming in here with no food. Half this estate worries about where the next meal is coming from."

Retired dinner lady

Higher yields from agriculture have not prevented malnutrition in Britain. The deficiency, however, is not so much in calorie requirements, the quantity of food, as in nutrients, the quality of food. A study of low-income women in upstate New York defined food poverty as:

> "the inability to acquire or consume an adequate quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so".

As economists Jean Drèze and Amartya Sen point out:

> "What we can eat depends on what we are able to acquire. The mere presence of food in the economy, or in the market, does not entitle a person to consume it."

Since the early 1980s, food poverty has increased in Britain. Prolonged high rates of unemployment, the sharp increase in income inequality, the declining value of real wages and welfare benefits, and higher indirect taxation (for instance, value-added tax on a widening range of goods and services) have all systematically eroded the capability of many individuals and communities to secure food.

The numbers of people living in poverty (defined by the EU and OECD as earning less than half the average household income) rose from five million in 1979 to 14.1 million in 1992/93 — one quarter of the British population. Today, nearly four million British children live in families with weekly incomes less than £115, half the average earnings — up from 1.4 million in 1979.

Households at the lowest levels of income are unlikely to be able to afford a "modest but adequate" diet. A 1991 National Children's Home (NCH) Poverty and Nutrition Survey of families attending NCH family centres found that:

- 20 per cent of parents and 10 per cent of children had gone hungry in the month before the survey because they did not have enough money to buy food;
- two-thirds of the children and over half the parents were eating nutritionally poor diets;
- nearly half the parents had gone short of food in the past year to ensure other family members had enough to eat.

A 1993 NCH survey of low-income families found that half of those surveyed had to borrow money to buy basic necessities including food; nearly half of those with earned incomes sometimes did not have enough money to eat; and average weekly spending on food was only £9.10 per person — even though this was still one-third of their income. Low-income women, invariably responsible for food provisioning for their families, absorb most of the stress of food poverty.

The average proportion of household income spent on food has decreased steadily from just over 30 per cent in 1940 to 12 per cent today. But the proportion spent on food by the poor is far higher: the poorest fifth of the population spend 25 per cent of their total income on food — recent government research has indicated that such households would have to spend more than 30 per cent to have a healthy diet.

Poorer people usually have to pay more for their food for several reasons, not least because the supermarkets have fled the High Street for out-of-town greenfield sites. People without cars are left to shop at corner shops, convenience stores or independent small supermarkets where prices are on average 23 per cent higher than those in large supermarket chains and discount stores.

Added to the cost of food is that of transport. As a woman living with her husband and two children pointed out, "It costs us £7 to get to the shops and back — and we are only spending £30 a week on food for all four of us."

The requirement to "fill up" is the overriding priority for many low-income consumers. One mother of two children living on benefit said:

> "Everyone on benefit wants to feed their children better, but you tend to think of them having enough food so they're not hungry rather than good quality food and be feeling a bit hungry between meals."

Faced with this dilemma, it makes sense to shop for cheap, filling food rather than fresh fruit and vegetables. The diets of more than one in four women in households receiving benefits were deficient in iron, vitamin A, thiamin, riboflavin, vitamin B6 and vitamin C.

People from lower socio-economic groups tend to have lower micro-nutrient intakes because of the poorer quality of their food. One study found that the nutrient density (the amount of nutrients per 1,000 calories) of foods eaten by poorer people was 20 to 25 per cent less than foods eaten by the better-off.

By far the most energetic action on tackling food poverty has come not from government, but from within deprived communities, which have set up projects to improve access to healthier food, for instance, food-buying cooperatives, bartering and subsistence agriculture. Such community action needs to be supported, however, by adequate resources and a measure of real power in the local food economy, for instance, over decisions as to where shops will be sited.

Source: Leather, S., *The Making of Modern Malnutrition: An Overview of Food Poverty in the UK*, The Caroline Walker Trust (6 Aldridge Road Villas, London W11 1BP, UK) 1996, £10.

system which pays farmers to maximize their yields on some of their land and pays them to set aside other areas and grow nothing.

In addition, although food has never been so cheap in Britain, poorer people still cannot afford to eat well.[40] Richer people are less likely to die from diet-related disease than poorer people.[41] Processed, usually fatty and sugary, foods are cheaper in calories per pence than fresh fruit and vegetables. They are often ready to eat, saving on consumers' fuel bills. With limited public transport and few supermarkets or markets nearby, people living on housing estates are often dependent on local shops which stock a limited range of products and which exploit their near monopoly status by charging very high prices.

Food growing projects can enable people to become healthier by providing access to affordable, fresh, organic produce, particularly fruit and vegetables. This can include some of the "exotic" foods available in supermarkets — the warmer microclimate of cities enables more delicate fruit and vegetables to be grown. Some ethnic community projects, for instance, grow foods such as okra, coriander, callaloo and karela which are otherwise unavailable in Britain or prohibitively expensive.

Growing food can also be a useful form of physical activity. Only an estimated eight per cent of the British population are sufficiently active to reduce their risk of coronary heart disease.[42] Some doctors in the UK have begun to "prescribe" exercise to patients as a form of disease prevention, an idea which could be developed to include gardening activities and related cooking and nutritional advice.

But while gardening is already a popular activity in Britain — a recent survey showed that 56 per cent of adults spend around two hours a week gardening, with one in ten spending at least seven hours a week[43] — most gardeners grow flowers and other ornamentals only and make liberal use of artificial pesticides and chemicals in the process. In 1995, British households used nearly 1.6 million kilogrammes of chemicals on their gardens.[44] Some of this skill and enthusiasm could be harnessed into growing food (without excluding or entirely replacing flowers and lawns) and organic methods of cultivation.

Gardening has also long been recognized as a way of dealing with stress — in fourteenth century Ireland, monks gave care to "troubled people" by involving them in monastery gardens.[45] In the mid-nineteenth century, British local authorities noticed that the well-being of poor patients labouring in hospital gardens was better than that of their richer counterparts incarcerated indoors, largely in seclusion and looked after by servants. In response, horticultural activities were instituted which, albeit in changed form, are still running today.

Around six million people are diagnosed each year in Britain as mentally ill, the commonest problems being anxiety and depression which account for 80 per cent of mental illnesses.[46] Some Care in the Community service providers operate horticultural projects. For instance, "Restore", a project in Oxford, involves participants not only in cultivating a series of allotments, but in cooking and eating together in the communal kitchen, and selling their jams, chutneys and fresh produce to the local community.

Community Regeneration

"Restore" is just one example of a project which fosters a sense of community, both among the workers and between workers and the rest of the community. Although difficult to quantify, this "sense" can be one of the most valuable aspects of food growing projects. Garden plots can stimulate a sense of common ownership and, in doing so, spur a sense of community into existence. This community may then move on to further collective action on issues of local importance.

For instance, the residents of Apple Tree Court, a housing estate in Salford, an inner city area of Manchester, have started to grow their own solutions to problems of poverty, unemployment, infrastructure decay and a dearth of adequate food shops. They have dug up the barren, windswept lawn surrounding the block, laid out vegetable plots, planted fruit and nut trees, created a wildlife area, made a pond and put in outdoor seating. The ground floor of the block has been turned into a community café and a food co-op is being established. People from the neighbouring community — school children, conservation volunteers, young people on probation and the unemployed — have come to visit or help. As the tenants' confidence has grown, they have formed a tenant-managed co-op, and are now in control of the block's finance and management. The estate's first harvest was reaped in 1995, some of which went to the main workers, the remainder being sold to other residents for 10 pence a pound with the profits going back into the co-op. The residents now plan to use the waste heat from the building to grow food in polytunnels on the roof.

Allotment sites and other food growing areas often bring together a diverse range of people. Exchange of information, on matters such as gardening techniques, vegetable varieties or cookery advice, can help break down barriers of age, class, race and gender and broaden people's understanding of different cultures. Involving ethnic groups in food production (an area where many first generation immigrants are highly skilled) illustrates that "local" does not necessarily mean white.

Philadelphia Mississippi

The unrelenting view through the railway carriage window for tens of thousands of commuters travelling through a poor, working-class neighbourhood of North Philadelphia is of crumbling factories and warehouses — except for Glenwood Green Acres, the city's largest vegetable and flower community garden. The four-acre farm is divided into one hundred garden plots separated by white picket fences and contains a dozen tool sheds, dozens of red and blue water barrels — and a red freshly-painted railway carriage, the "office" of the Green Acres garden club donated by Amtrak.

Club president Jimmie Taylor, explained how this stretch of industrial-residential land, which used to be occupied by warehouses, came to be an urban garden:

> "First, there was whiskey aging in barrels, then a tyre company took it over. There were fires all the time until the buildings were abandoned in the early 1980s."

Taylor complained about the fires to the mayor's office regularly and worried about vandalism and arson in the vacated warehouses. In early 1984, the mayor told him to:

> "'go home and sit on your porch [across from the site] . . . You're going to see wrecking cranes and bulldozers' . . . Sure enough they came in June of that year."

After the buildings were razed and cleared, Jimmie and his wife Ruth decided that if they didn't do something with the land, people would use it as a dump. "I suggested a community garden. She said, 'fine'."

A neighbour suggested that they call Philadelphia Green, the largest comprehensive community greening programme in the United States which provides soil, trees, growing barrels and technical advice to low-income communities.

Someone from Philadelphia Green visited the Taylors that afternoon and discussed the resources the greening programme could provide. "You get me started", Jimmie Taylor told them, "and I'll do it." The programme delivered fencing wire, while Taylor and a friend put up the chain-link fence that surrounds the site. In time, he designed and installed an ingenious water system: pipes and hoses run from a hydrant in a nearby street, approved by the city authorities for use by Green Acres, to spigots which fill 55-gallon drums located strategically throughout the four acres.

Since 1984, he has been assigning plots to would-be gardeners, advising people on horticulture and garden care, convening meetings and enforcing the rules of the garden club.

When Jimmie gives a plot to a new gardener, he does so on a trial basis for one year. He points out that drugs came in the 1970s "like a poison", infecting the young people and shattering the community. For this reason, he claims he won't give a garden to someone in their '20s. "Kids born in the '60s, they're okay. It's when drugs started that the trouble started." His principle is not absolute, however, as two women who garden at Green Acres look to be no more than 25-years-old.

Jimmie Taylor says he prefers women gardeners to men gardeners because they take more responsibility. The same goes for the women staff at the Philadelphia Green programme. "Women get more done; they're more responsible for their jobs."

The elders of the Glenwood Green Acres garden project do not want their skills and their tradition to die with them. Many of them share a common past: disciplined, hardworking childhoods on farms in the South of the United States, in places like Mississippi and North Carolina, with close ties to the land, then migration to Philadelphia to work in factories, warehouses and "city jobs". In retirement, encouraged by Philadelphia's boom in urban gardens and the opening of Green Acres, they have had a chance to revive their farming skills.

In the spring of 1990, eight gardeners over 60 years of age held a one-day workshop at Green Acres for 40 children from the Busy Bee Garden to share their heritage of planting techniques and history, especially for traditional crops like sweet potatoes, cotton and peanuts, which had been passed on to them by their grandparents.

One of the elders, Alice Cooper, showed her audience how to separate seed from cotton, she commented on the inefficiency of reaping machines. "Back then, there was no machine. This was the only machine", she said as she held up her hands. "With machines, you can't do a second pickin' 'cause the machine destroys the plant. With your hands, you can go back maybe three times."

From another gardener, the children learned how to till green manure crops into the earth, while a third recounted the day her grandfather took her aside and said, "I'm goin' to teach you how to grow somethin' and you'll never be hungry".

At the end of the day, the children talked about what they liked best: "When you finish planting it and picking it, you get to eat it".

Extracted from Hynes, H.P., *A Patch of Eden: America's Inner-City Gardeners*, Chelsea Green Publishing Company, 10 Water St, Room 310, Lebanon, NH 03766, USA. $18.95 (Green Books, Foxhole, Dartington, Totnes, Devon TQ9 6EB, UK. £14.95)

Radical Change

The garden city need not be a utopian daydream. In fact, food growing is rather unremarkable. No grand scale change is necessary for urban food growing to re-root itself in British culture and practice, but rather a series of incremental transformations in the way people think and act. Many of the ingredients are already there. The government, in theory at least, acknowledges the links between environment and health. Most local authorities now have Agenda 21 plans and are keen for input as to how to implement their aims. The UK has a vigorous, if underfunded, non-governmental sector already working in community food growing. Gardening is a national pastime. Some people already grow their own food while others could easily adopt food-growing as an extension of the well-established dead-heading-roses routine.

A cohesive movement could bind all these elements together to represent the interests of food growers and to put urban agriculture on the political map. Such a development could lead to radical change, in the truest, most literal, sense of the word.

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Books

Market Women

ONIONS ARE MY HUSBAND: Survival and Accumulation by West African Market Women, by Gracia Clark, University of Chicago Press, Chicago, 1995, £18.25/$25.50 (pb) ISBN 0-226-10780-9

In the ongoing drama of twentieth-century African food provisioning, market women play a leading role. Government efforts to participate in food distribution have come and gone, largely discredited, while private sector supermarkets continue to cater, in most countries, to a limited clientele. "Traditional" marketplaces remain central to local and national food economies, even in the largest cities and in those parts of the continent with no precolonial tradition of marketplace food trading. While certain trades, such as grain wholesaling and meat, tend to be controlled by men, women almost invariably dominate the fresh produce sector, as well as much of food retailing in general.

Despite the fact that market women usually collect, transport and distribute food supplies far more efficiently than any state marketing body, state authorities have often blamed them for all manner of national food supply crises. Despite substantial evidence that most market women survive on long hours and perilously small operating budgets, stereotypes and popular legends focus on the flamboyantly wealthy "mama benzes" (owners of Mercedes Benzes) and the alleged monopoly power of the "commodity queens". Attitudes towards women traders illustrate how much women's economic and political power, combined with concerns about food security, are sources of considerable unease in contemporary urban Africa.

Gracia Clark's book, which focuses on the traders of the Kumasi central market in Ghana, situates the contradictory status of African market women in historical and cultural context, while providing a detailed account of their role in urban and national food economies. The book offers a great deal of information about how market women and food markets work, and about how their operations have been affected by changing government attitudes and recent structural adjustment policies. It provides rich detail and theoretical insights into the gender and spatial dynamics of contemporary African urban and regional food economies.

Onions Are My Husband is based on Clark's several years' fieldwork in Kumasi, conducted intermittently between 1978 and 1990. Over this time, she was able to observe both the immediate and longer-term effects of Ghana's structural adjustment programme, praised by the World Bank as one of Africa's few "success stories". In addition, she witnessed President Jerry Rawlings's violent and blatantly misogynist "house–cleaning" campaigns against the market traders, as well as the more recent moves toward electoral democracy. Clark has also drawn on Ghana's colonial archives for information on past market-state relations.

Perhaps the most valuable product of Clark's work is familiarity. She obviously knows her subject well which enables her to make effective use of both intimate detail and broad historical and geographic analyses.

The book is divided into four parts. The first examines the marketing system as a whole, while the second and third sections focus on the market traders' individual and group strategies of survival and resource access. The final set of chapters steps back to examine the role of the market and its traders in contemporary state and class formation and in the ongoing redefinition of gender, kin and ethnic relations.

More than most ethnographies of African market traders (as opposed to studies of markets and trade networks), Clark's book examines the geographic and spatial bases of social organization and power. At one level, geographic origins serve to place, or identify, people and products. Traders often choose to deal in produce from their home region, because they know its agricultural seasons and the language and expectations of its customers. They may also seek resources and solidarity in the urban community of migrants from their hometown.

Within Kumasi market itself, location is critical to successful commerce. Much of the produce market is organized by commodity as well as by function (that is, wholesale versus retail), so traders must try to sell where the most customers for their particular product come regularly to buy.

Although the market is physically much more open and public than, for example, a North African bazaar, sellers located in specialized areas, such as the tomato "line" or the orange wholesale yard, have better access to current price and supply information about their commodities than those who sell in the streets or distant neighbourhood markets.

Resident traders in the central market wholesale yards occupy an especially powerful position, because they are assured a large and steady customer base as well as privileged access to shipments and information from around the country. Finally, certain locations within the marketplace also offer better amenities, such as shade-storage facilities, and a sense of community among stall neighbours.

Clark emphasizes, however, that the "power of location" is not fixed: a central place may not always be so. Depictions of marketing networks as rigid matrices, organized hierarchically by function, overlook the extent to which the regional or urban geography of commerce is, at any one time a product of "constant fluidity and intense contestation". In modern Ghana, disputes over access to market space and transport occur regularly, and traders must be able to change trade routes, supply sources and merchandise in order to adapt to market shutdowns, drought and fuel shortages.

Because the geographic conditions of commerce can shift widely and rapidly, flexibility is crucial to the stability of not only individual traders' enterprises, but also entire food distribution networks. Clark devotes considerable attention to individual and group methods of securing locational advantages as well as surviving changes in market and supply locations. Some strategies call on kin and ethnic relations for access to stall space, transport or scarce produce supplies.

Contrary to many studies of African commerce, Clark finds that blood ties are less important to the organization and stability of the market than the peer (or "colleague") and customer relations within various commodity trades. She

attributes the absence of specialized trading families in Kumasi marketplace trade to the relatively easy entry requirements.

Individuals do not need family connections or large amounts of capital to get started; to get ahead, they must seek other sources of information, credit and solidarity. These they typically find in loosely defined "commodity groups," whose members trade the same goods and frequent the same part of the market, but whose age, experience, wealth, and trading roles and interests (that is, as wholesalers, retailers, travellers) vary widely. Clark emphasizes that their relations involve in most cases, neither complete collaboration nor patron-client forms of exploitation. Rather, they are interdependent, and their common need for reliable information and steady business requires that they temper potentially destructive competitive behaviour with a degree of cooperation and respect for certain rules of conduct.

Here the leaders of the commodity groups, the *ahemma*, play a particularly important peacekeeping role. A chapter on the "queens of negotiation" makes a valuable distinction (often neglected in more superficial discussions of women traders) between the wealthiest traders and those who wield the most political influence, both within and beyond the marketplace. The *ahemma*'s most important quality is not their wealth — the richest traders, in fact, are usually considered too preoccupied with their own careers — so much as their ability to settle internal disputes and represent their peers' interests in negotiations with government officials, farmers and truck drivers' unions. During the 1979-80 marketplace crackdowns, for example, the *ahemma* helped minimize confusion over new price control laws and currency devaluations.

Official and popular discourse during the market "housecleaning" often referred to the traders as simply "the women." The female identity of marketplace trade is a fairly recent historical development, but it reflects long-standing cultural influences. Historically, Ghanaian women's participation in commerce increased most dramatically during the 1920s and 1930s, when increased European control over the import-export sector limited opportunities for Africans, and Ghanaian men abandoned trade for more lucrative and prestigious employment in cocoa farming and the civil service. Culturally, Asanti values emphasizing hard work and economic autonomy justify women's participation in trade, and flexible forms of kin and marital relations allow them to mobilize resources and build independent enterprises in socially acceptable ways. But customary gender norms also subject women to heavy domestic responsibilities which limit how much time and money they can invest in trade. In other words, the historical conditions and daily gendered practices which make accumulation in marketplace trading so difficult also define it as "women's work".

Certain obstacles to successful trade, however, can be negotiated. Some of Clark's most intriguing ethnographic work centres on the strategies Asanti women use to extricate themselves from time-consuming domestic tasks without neglecting the demands of "home and husband". The sexual significance of cooking poses a particular challenge to ambitious traders; hiring a maid to prepare the evening meal virtually invites a husband's infidelity. Childcare, by contrast, can be easily delegated to an attentive daughter or neighbour.

Some aspects of the Ghanaian market women's historical experience have been unusual, if not unique. Police harassment, for example, has rarely escalated into anti-trader campaigns as violent as Jerry Rawlings's bulldozing and beating rampages in 1979-80 (though there have been similar incidents in Nigeria and Kenya). The Kumasi women's future, however, holds questions relevant to market traders throughout sub-Saharan Africa. What will be the long-term consequences of economic liberalization and IMF-World Bank austerity programmes?

In Ghana, structural adjustment brought a welcome relaxation of trade restrictions, helping to end arbitrary shortages and confiscation of consumer goods. But higher living costs and more competitive trading conditions (industrial and civil service layoffs have sent many women and men into petty commerce) are placing considerable strain on the market women's budgets as well as on their customary forms of mutual aid. Clark suggests that the relatively egalitarian relations within commodity groups may become more hierarchical and exploitative if struggling retailers and travelling traders become heavily indebted to wealthy wholesalers; depressed consumer demand and harsher credit conditions may increase bankruptcy rates.

Political developments appear more hopeful: Ghana's recent efforts to decentralize government has permitted, even encouraged, market women, farmers and other less-educated citizens to run for local office. Such overtures to popular participation in Ghana, and Africa generally, may help women traders survive and define the terms of economic adjustment. Less optimistically, "democratization" might prove an empty palliative; elections alone will not assure food on the table for the market women or any of their customers. As *Onions Are My Husband* illustrates, market women's ability to provision the cities as well as their own families is likely to remain a crucial determinant of urban food security.

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How Many is Too Many?

WORLD WAR III: Population and the Biosphere at the End of the Millennium, by Michael Tobias, Bear & Co., Santa Fe, New Mexico, 1994, $29.95/(hb) 649pp. ISBN 1-879181-18-5

An estimated 5.7 billion people live on the earth and give birth to some 90 million more people each year. Population experts, politicians and the general public all recognize that a rapidly-growing population in a world characterized by

extreme inequity, poverty and environmental degradation can only lead to a future of crisis, chaos and misery.

They disagree, however, on the precise relationships between numbers and problems, and on devising realistic solutions to the problems. How many is too many? Is our world really faced with a problem of overpopulation, or is it one of overconsumption? Are population rates booming because people are responding to dire conditions, or because they are celebrating an improved standard of living?

At first glance, Michael Tobias's *World War III: Population and the Biosphere at the End of the Millennium* seems to offer enlightenment on these matters. His preface promises the reader a summary of the world's global population-growth experiences and a vision of a sustainable future as an alternative to the apocalypse suggested in the book's title. With chapters covering the environmental implications of population growth in the five most populated bioregions of the world — China, India, Africa, Indonesia and the United States — Tobias depicts a world of chaos and carnage, with population growth directly linked to environmental degradation.

In China, some 70 per cent of people are directly dependent upon agriculture but since 1949, the country has lost over 50 per cent of its arable land to industrial expansion. The need to feed an ever-expanding population (as of mid-1992 some 1,166 million people) has put enormous pressures on agricultural policy. The response has been to plough up grasslands, drain wetlands, and create massive water projects such as the Three Gorges dam now under construction. The resulting habitat loss has meant that at least 257 animal and 354 plant species are heading for extinction, including the Chinese rhinoceros, wild horse, wild elephant, mandarin duck, golden monkey, panda, snow leopard, dolphin, alligator and tiger.

Similar tales of population pressure spurring forms of agricultural and industrial expansion that demolish critical wildlife habitat are found throughout Tobias's book. In each case, the loss of forests, expansion of deserts and contamination of air and water are linked to human action prompted by expanding populations.

Tobias uses his survey of environmental horror stories to introduce the main point of his book: existing efforts to respond to the obvious crisis in population and the environment are not working. He argues that efforts to control population growth are constantly undermined by the assumptions and contradictions of national and international population policy which sees economic development as the key to controlling reproductive rates.

According to Tobias, strategies aimed at slowing the rate of reproduction involve improving the human condition in areas of health, education and economic opportunity. Improvements are brought about through an intensification of resource use with the goal of increased standards of living. It is believed that improving the quality of life for families, including access to family planning, will prompt people to choose to have fewer children, and population rates will stabilize. Tobias maintains that this projected stabilization will occur at the cost of the environment as countries across the world strive to achieve the US consumer lifestyle. But the projected stabilization of the global reproductive rate may never occur, according to Tobias, because improved living conditions will allow people to afford to house, clothe, feed and educate a larger family.

Tobias has much to say in this obviously well-researched book. How he says it, however, obscures his content and message. Rather than clarify, he leaves the reader confused. In attempting to describe the histories, realities and future implications of life for most people on the planet, Tobias puts any and all information in his text. The result is a 609-page book where facts, figures, anecdotes and personal reflections are all jumbled together.

In his chapters on China, India, Indonesia and Africa, Tobias's writing jumps from the personal to the analytical and back again, framing and occasionally interrupting factual accounts with reflective and, at times, arrogant musings. His observations and descriptions are full of value-laden terms: people in China "multiplied with inexorable zeal", while those in India, Africa and Indonesia are caught up in a "breeding frenzy" sustained by a "blood lust" for meat and an ever-expanding hunger for food, resources and consumer goods.

He describes practitioners of Jainism (an Indian religion which practices non-violence and respect for all living things) as compassionate, altruistic, gentle and holy, while depicting the majority of Indians as "corpse-eating . . . illiterates" whose culture encourages and delights in the "infliction of pain" on other living creatures.

The assumptions structuring Tobias's analysis are disturbing: humans no longer abide by the laws of nature; human activity means the death of nature; and the only real solution is to revolutionize human/environmental relations via population control and massive global "social engineering" of a "new human nature".

For Tobias, as for many environmentalists, the only hope for the future hinges on a planetwide shift from the culture of consumption to the culture of non-violence and respect for all living things.

Where Tobias moves from the mainstream to the radical fringes is in his ideas for accomplishing this shift. The "social engineering" of a "new human nature" will not come about, according to Tobias, if human rights means the right to exploit and consume other living things. "Human rights" he argues, "have got to be *overcome*, somehow conquered."

Tobias envisions and advocates planetwide dietary shifts, outlawing the consumption of meat and the use of animal products. Couples should be allowed one child at the most. Free trade should be abolished and all countries, industries, businesses and financial institutions should be required to act according to their bioregional carrying capacity. Economic growth should cease. Ecological concerns should be recognized as national and international security issues. Military spending should cease and the funds used for domestic and international family planning, health care, education, equal opportunity for women and indigenous peoples, and cruelty-free standards of nutrition for all.

The US Constitution should be amended to abolish the right to bear arms and to create a right for all individual animals and vegetation to live free of human exploitation of any kind. All countries should work together to develop alternative energy sources. All government subsidies should cease except those encouraging "green" endeavours. A Global Environmental Protection Agency with an environmental police force should be created to monitor and implement this new world order. An international body should be formed to regulate migration on the basis of environmental integrity. And finally, the principles, priorities, moral choices and practical methods of non-violence should be incorporated at all levels of global society.

Some of these ideas present a realistic path for humanity, such as funding women's health, education and welfare and redefining human rights as a right to a healthy environment.

Other notions, however, are not only utopian but also autocratic. The social and political implications of Tobias's socially-engineered "new human nature" is a world defined by a single set of values based on his interpretation of "natural law" or basic obligations to other life forms. There is no room for cultural diversity. All human endeavour is controlled by a centralized system of authority. Human rights are replaced, rather than enhanced, by the biosphere's right to life.

In sum, the health of the biosphere is valued over the health of humanity. Tobias posits a nice world to visit, but I wonder who will be allowed to live there.

Barbara Rose Johnston

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Small is Successful

REGENERATING AGRICULTURE: Policies and Practice for Sustainability and Self-Reliance, by Jules N. Pretty, Earthscan, London, Joseph Henry Press, PLACE,1995, £12.95/$14.95 (pb) 320pp. ISBN 1-85383-198-0

Any book opening with section entitled "A Vision for Agriculture" is bound to be an ambitious volume. Indeed, introducing sustainable agriculture with a rather turgid appraisal of the positivist paradigm and the nature of truth is a little overpowering. But after this initial ducking in the muddied waters of seventeenth century philosophy, *Regenerating Agriculture* proceeds along more conventional lines.

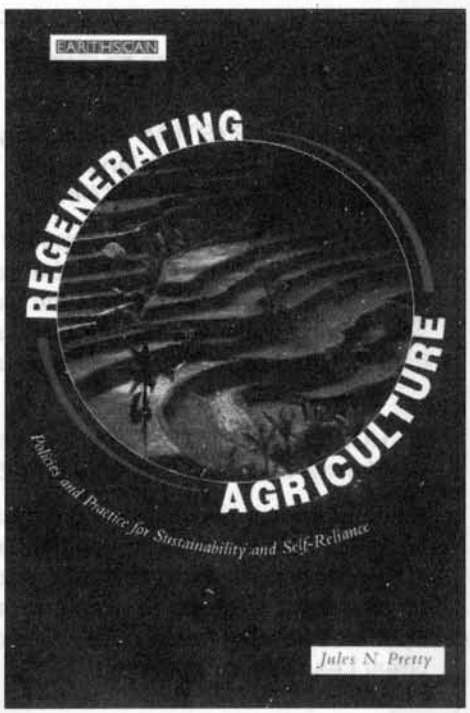
Pretty provides a useful insight into the transformation of rural environments worldwide in the past century, maintaining that the demands of an increasing population and the development of agricultural technologies catalysed dramatic changes. Modern crop varieties and the mass production of synthetic pesticides and fertilizers provided the ingredients of the Green Revolution and were swiftly adopted in both industrialized and developing countries. But while production has undoubtedly and dramatically increased, there have been many unforeseen social and environmental costs.

Pretty attributes the rapid uptake of these new technologies as much to subsidies as to farmers' enthusiasm. The tradition of government intervention in agriculture is long established in most countries. In the early years of this century in the United States, favourable homestead policies and a high wheat price encouraged farmers to expand cultivation westwards. In 1919 alone, some 4.5 million hectares of grassland were ploughed for the first time to grow wheat. The results are not encouraging: within a generation, dust storms began. Dust and earth blanketed houses and eventually 50 million hectares were severely affected by erosion.

Government intervention continued with the Green Revolution. Indonesia in the 1960s, for instance, relied heavily on rice imports. In an attempt to increase domestic production and reduce its imports bill, the government introduced pesticide subsidies of 85 per cent. Rice production tripled in less than 30 years but by 1989, excess chemical use had caused pest resurgence. With pesticides proving increasingly ineffective, the government abolished the subsidy, saving itself around US$150 million in the process.

Governments have also tried to intervene to combat soil erosion, starting in Africa in the 1940s with the construction of terraces and earth embankments called bunds. Throughout the 1960s, thousands of hectares were "protected" in this way at a cost of over US$2,000 per hectare. The terraces filled with sediment, were impossible to maintain and began to aggravate erosion. Within a few years of construction, 20,000 hecatres of terraced land in Kenya was in disrepair. Similarly, in Burkina Faso, 120,000 hectares of earth bunds constructed in the 1960s had all but disappeared within a decade. In Ethiopia in the 1980s, 200,000 kilometres of terracing was built; within a year, 40 per cent of it was broken.

Pretty points out how the rush to maximize agricultural production has had profound social consequences for farming communities as well. In the US, family farms have declined dramatically and rural poverty increased; farmers are now twice as likely to commit suicide compared



with the rest of the population. Younger generations are less willing to continue the farming tradition. Most farmers in Japan, for instance, are over 60 years old.

Pretty blames many of these problems on the governments and agencies who promoted the Green Revolution. He sees projects as often ill-conceived and devised on a grand scale entirely inappropriate to the local context. In many cases, off-the-shelf technology is foisted on farmers with no concession to their complex farming systems, many of which had been performing sustainably without damaging natural resources or the environment for hundreds of years. Indigenous rural knowledge and conservation practices were assumed to be primitive and unscientific and have therefore been largely ignored.

Many of the projects either demanded huge levels of subsidy or, being on marginal land, required high levels of input for meagre yields. Either way, the hope that any environmental or yield benefits would continue beyond the length of the project was fanciful. In such cases, the operators might have been better advised to save the money and buy grain on the open market instead.

Pretty sees these government efforts as well-intentioned but as an expensive, ineffective and ultimately destructive influence on agriculture. In his view, resource-degrading farmers still incur nothing of the environmental or social cost they impose on the land and the wholesale subsidy of these projects only acts to undermine the need to find sustainable solutions in crop production. The arro-

BOOKS DIGEST

- THE FOOD SYSTEM: *A Guide*, by Geoff Tansey and Tony Worsley, Earthscan, London (Island Press, Washington, DC) 1995, £15.95/$26 259pp. ISBN 1-85383-277-4.

An excellent and accessible overview of the entire food system in all its complexity and its role in the global economy. The focus, however, is on "the rich, industrialized world where the global food system is being developed and promoted" because "food issues are linked to the exertion of power, influence and control by the different actors within the system".

- HUNGRY GHOSTS: *China's Secret Famine* by Jasper Becker, John Murray, London, 1996, £13/$19.95 (pb), 352pp. ISBN 0-7195-5440-3.

Some 30 million people starved to death throughout China between 1958 and 1962. "No blight destroyed the harvest", points out Jasper Becker. "There were no unusual floods or droughts. The granaries were full." Based on interviews, eyewitness accounts and unpublished documents, the author illustrates how the famine was created when Mao Zedong instituted various Great Leap Forward policies.

- ZAPATA'S REVENGE: *Free Trade and the Farm Crisis in Mexico*, by Tom Barry, South End Press, Boston, 1995, $16.00 (pb), 317pp. ISBN 0-89608-499-X.

Tom Barry shows how the pursuit in Mexico of neoliberal and free trade policies have reduced food security, degraded the environment, increased rural-urban polarization, depopulated peasant communities, and caused social and political instability. He links the crisis in subsistence agriculture and the impact of the domestic and international market with the "armed rebellion of campesinos whose rallying cry was land, justice and democracy".

- AGRICULTURAL BIOTECHNOLOGY AND THE ENVIRONMENT: *Science, Policy, and Social Issues*, by Sheldon Krimsky and Roger Wrubel, University of Illinois Press, Champaign, IL, (Trevor Brown Associates, 114-115 Tottenham Court Rd, London W1B 0BY) 1996, $18.95/£12.60 (pb), 294pp. ISBN 0-252-06524-7.

This volume examines the direction of genetic engineering's research and development in agriculture, both crops and animals, considering in particular the factors which shaped these directions and why certain paths were taken rather than others. It provides a useful summary of research since the 1980s and outlines the range of interest groups involved in the public debate.

- BEYOND BEEF: *The Rise and Fall of the Cattle Culture*, by Jeremy Rifkin, Thorsons (Harper Collins) London, 1994, £8.99 (pb), 353pp. ISBN 0-7225-2979-1.

Now published in paperback, Jeremy Rifkin's 1992 examination of beef eating in the Western world has already become a classic. Outlining various Western cultures long-standing relationship with cattle, he describes how beef was industrialized last century in a process which continues today. Some of the results Rifkin documents are how people starve while cattle are fed grain and widespread environmental degradation. He concludes with an analysis of how beef eating "has been used as a tool to forge national identity, advance colonial policies, and even promote racial theory".

- THE SPIRIT OF THE SOIL: *Agriculture and Environmental Ethics*, by Paul B. Thompson, Routledge, London and New York, 1995, £12.99 (pb), 196pp. ISBN 0-415-08623-X.

The author examines environmental problems in industrial agriculture such as the use of chemical pesticides and genetic engineering from various ethical perspectives or "worldviews" — productionism, stewardship, economics and holism — and concludes with a formulation of sustainability.

gance of agencies who attempt to force technology onto knowledgeable farmers is substantially eroding cultural and biological diversity.

In contrast to the grandiose schemes of the Green Revolution, the scale of sustainable agriculture projects seems meagre. One of the more dramatic examples Pretty cites is Cuba. Following the collapse of the Soviet Union in 1990, the country's supply of subsidized crop chemicals, petrol and foodstuffs was cut by over 50 per cent. This forced the government to reduce its reliance on chemicals while increasing food production. The approach was village based and involved scientists and farmers working together. It achieves much of what Pretty regards as essential for a successful and sustainable agriculture — a small-scale approach where agencies work with farming communities to devise specific solutions appropriate to each locality. Many of the biological control measures introduced were found to be more effective than the pesticides they replaced.

Closer to home, public concern over pesticide residues and environmental degradation has done much to promote sustainable agriculture in Europe and the United States. Many countries have now set official targets for pesticide and fertilizer reductions, and for the development of management strategies relying less on chemical means of crop production.

The vision is complete. Whether it becomes a reality is more uncertain.

Kate Munro

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Rights over Resources

MAKING NATURE, SHAPING CULTURE: Plant Biodiversity in Global Context, by Lawrence Busch, William B Lacy, Jeffrey Brukhardt, Douglas Hemken, Jubel Morago-Rojel, Timothy Koponen and Jose de Souza Silva. University of Nebraska Press, Lincoln, USA and London, UK, 1995, £40/$42.50, (hb) 261 pp. ISBN 0-8032-1256-9.

A complicated web of events accounts for the widespread attention now being paid to plant genetic resources. Food and anti-patent activist Pat Mooney has traced this attention to the "seed wars" which

broke out in the late 1970s at the annual conferences of the Food and Agriculture Organization. Two prime concerns were voiced at that time:

—the disparity in global seed exchange, whereby farmers' varieties and landraces are treated as common property, while formally bred varieties are legally protected and commercially transacted;

—growing concern at the loss of landraces following the adoption of high yielding varieties.

Making Nature, Shaping Culture sets out to review some of the problems arising from these concerns. It analyses why genetic resources have dwindled and details the various multilateral institutions and negotiations devoted to arresting the fall.

From the outset, the authors reject utilitarian principles as a way of tackling the problem. Within a cost-benefit matrix, for instance, the possibility of germplasm conservation is reckoned only in terms of apparent monetary benefits such as increased agricultural productivity. Lawrence Busch and his colleagues conclude that it is necessary to move beyond this limited notion; they appeal for the responsibility "we have to present and future generations and perhaps to nature itself" to be incorporated in problem-solving. Their analysis concludes:

> "Our ultimate hope is that in the matter of germplasm, as in all other matters, we begin to re-establish a culture of care."

To appreciate this plea, one has to understand the authors' approach. Their initial premise is that "nature is not natural" — by "natural" they mean an existence independent of human action. What we know of nature, however, is invariably a result of human intervention, evaluation and activity. Throughout history, humans have socialized plants and animals, thus making and re-making nature.

They go on to characterize science as "technoscience", a term popularized by French sociologist Bruno Latour which indicates the close proximity science has to technology. It also signifies that scientific and theoretical developments are difficult to disentangle from commercially tangible products. In its contemporary setting, Busch and his colleagues claim that technoscience has distanced itself from society, a distance manifested in the fact that most citizens are disenfranchised from the decision-making process. Since human ability to transform

BOOKS DIGEST

- THE POLITICS OF DOMESTIC CONSUMPTION: *Critical Readings*, edited by Stevi Jackson and Shaun Moores, Prentice Hall/Harvester Wheatsheaf, London, 1995, £15.50/$27.95, 351pp. ISBN 0-13-433343-8.

The contributions to this collection emphasize the relationships of power and social inequality operating within and between households, particularly those with gendered and generational aspects. The various essays explore the economics of domestic consumption, the significance of food and clothing in family life, and the uses of household technologies such as food processors.

- EUROPEAN AGRICULTURE: *Policies, Production and Trade*, by Brian Gardner, Routledge, London and New York, 1996, £13.99 (pb), 233pp. ISBN 0-415-08533-0.

The Common Agricultural Policy (CAP), central to economic and environmental issues in the European Union, is under pressure to be reformed, not least from those Eastern European countries who wish to join the Union. This book outlines the workings of the CAP and its impact on farming in Europe. It analyses the policy's reform in 1992, the 1994 GATT agreement and the reasons for its expensive continuation.

- THE RURAL ECONOMY *and the British Countryside*, edited by Paul Allanson and Martin Whitby, Earthscan, London (Island Press, Washington, DC) 1996, £14.95/$25 (pb), 226pp. ISBN 1-85383-365-7.

Farming in Britain is declining in importance as a source of income and employment. The resulting outflow of rural workers and inflow of city commuters has transformed the social composition of villages. EU policy, meanwhile, is increasingly influential in regulating the countryside and promoting rural development. This volume of essays explores how the changes in rural areas are reflected in agricultural and planning policies and investigates whether such policies reinforce inequalities within society.

- ISSUES IN AGRICULTURAL BIOETHICS, edited by T.B. Mepham, G.A. Tucker & J. Wiseman, Nottingham University Press (Manor Farm, Main St, Thrumpton, Nottingham) 1995, £70 (hb), 413pp. ISBN 1-897676-514.

"For a substantial number of people", note the editors of this essay collection, "the desirability of increased food productivity can no longer be assumed" because of its "costs" — its effects on food safety, animal welfare, environmental sustainability, security of employment and social justice.

- THE CENTRALITY OF AGRICULTURE: *Between Humankind and the Rest of Nature*, by Colin A.M. Duncan, McGill-Queen's University Press, Montreal & Kingston (UCL Press, London, UK), 1996, £28.00 (hb), 312pp. ISBN 0-7735-1363-9.

In reviewing the history of capitalism and socialism in relation to agriculture, environmental historian Colin Duncan argues that theories of political economy have been sidetracked by industrialism and thus overlooked the critical role of agriculture in society. He traces the development of capitalism in England to illustrate his case.

- SUSTAINING THE SOIL: *Indigenous Soil and Water Conservation in Africa*, edited by Chris Reij, Ian Scoones & Camilla Toulmin, Earthscan, London, 1996, £12.50/$22 (pb), 272pp. ISBN 1-85383-372-X.

Indigenous soil and water conservation practices are rarely acknowledge in the design of development projects. These 28 essays by 30 teams of African researchers explore the various factors influencing the adoption and adaptation of such practices; farmers' perceptions of conservation; and the institutional and policy settings which favour effective land husbandry. Several case studies from Niger, Burkina Faso and Mali illustrate how badly degraded land can be rehabilitated.

nature is largely manifested through technoscience, they maintain that it is crucial to democratize its practice, a process which would require the incorporation of an ethic of care and responsibility.

The book goes on to introduce a dual process: "how the world was one" — the global concentration of resources in few places — and "making the world one" — the homogenization of crop plants.

Their analysis of the concentration of resources relies on the familiar history of the "botanical chess game" (to quote Pat Mooney) characteristic of the colonial conquests of plant genetic resources which resulted in the building of botanical gardens and the physical possession of plants.

Today, such concentration is evident in the separation of food production from consumption, witness the increasing distance food travels before it reaches the table. The authors merely assert, however, that these processes contribute to the global concentration of resources without further exploration of how they have come about.

The homogenization of crops, meanwhile, has come about through the process of plant "improvement". A peculiar aspect of plant breeding is that it leads to the loss of genetic diversity: the contemporary breeder begins with diversity and variation so as to produce a uniform and stable plant variety. Again, the authors leave the reader midstream: why is uniformity the *predominant* objective of breeding programmes? Even if the result of breeding is a stable and uniform variety, why are fields today cultivated with monocultures rather than several, different crops?

A partial answer to the first question would involve exploring the political economy of plant breeding and the factors underpinning the demand for legislative protection. Uniformity and stability, meanwhile, are central requirements of plant breeders' rights which, over the past few decades, have been socialized as intrinsic objectives of plant breeding. Both uniformity and stability are primarily legal requirements that enable identification of a plant variety for the purpose of proprietary protection.

As to the predilection for monocultures, the authors note the pressures of competitive markets and consumer preference:

> "farmers operating in competitive markets wish to maximize their productivity . . . so farmers seek out the seed that will produce the highest yield."

It is inappropriate, however, to place this result solely on farmers' shoulders. Without doubt, farmers take decisions what to plant, but today few of them are able to act independently of agro-food corporations and, in many cases, are just another link in the industrial food production chain. Taking account of agro-food industrial complexes would have produced a very different conclusion about the predominance of monocultures.

Having set out their theoretical and analytical approach, the authors give several descriptive accounts of national responses to the loss of genetic resources within a country's borders. The lengthy case study of the United States provides a history of plant introduction, the development of the US Department of Agriculture, seed certificate schemes, national germplasm conservation and informal seed saving organizations. Unfortunately, there is little, if any, analytical elements in this descriptive history. A novel contribution would have been to compare the public and informal approaches towards the conservation of plant genetic resources, or even to have suggested measures at improving the weak links between the two.

Each of the other countries under the spotlight — France, Brazil and Chile — occupy a different position in the global paradox of competition versus cooperation. An explanation or comparison of their different experiences, however, is not given, a lacunae which undermines the promise of the book's methodological approach in combining nature and culture.

Therefore, although the book covers a tremendous amount of ground, overall it leaves a feeling of insufficiency, essentially the result of inadequate depth and limited factual detail.

For instance, the authors outline the loosely-coordinated international institutional structure governing plant genetic resources, which includes FAO, the International Undertaking (an attempt at FAO to address the issues of genetic erosion and inequity in global exchanges of germplasm, the International Agricultural Research Centres (IARCs), and the Convention on Biological Diversity. An unfortunate result of this wide canvass is that the brushwork is thinly spread: hardly two pages are devoted to the IARCs in an account which abruptly terminates in 1972 with mention of a Technical Advisory Committee-sponsored conference. The section on the International Undertaking is more detailed, but fails to mention the International Fund (the mechanism designed to support the conservation of genetic resources and the implementation of farmers' rights), and hardly takes note of farmers' rights. A prime concern of the Rio Convention is not even mentioned: the legal status of *ex situ* collections.

Meanwhile, the chapter on intellectual property rights, catchily titled "cultures of property", outlines the US experience of plant-related property rights. But inexplicably, neither GATT nor farmers' rights are mentioned, two critical international developments concerning plant genetic resources. The undefined requirements of GATT relating to the proprietary protection of plant varieties can potentially be used by developing countries to introduce legally farmers' rights as means of restoring some equity in the global exchange of plant genetic resources. Such legislation may also facilitate *in situ* conservation strategies which many NGOs have been arguing for.

The chapter leaves the reader confused about the authors' position on the patenting of plant genetic resources. They pose the question:

> "when and under what conditions, if at all, do we wish to consider germplasm as property? If we do wish to consider it property, should it be private?"

Their answer to this vexing question is provided in the next chapter:

> "intellectual property rights, if they are to be extended to life forms, should be of such length and scope as to permit the recovery of investment plus a reasonable return on that investment."

Even such a partial response as this reveals a capitulation to corporate demands for the extension of patents on life forms and also, surprisingly, contradicts some of the articulate positions stated elsewhere in the book.

Despite the promise of its title and the opening chapters, this book fails to deliver, a disappointment exacerbated by an awareness of the high calibre of the authors' previous writings.

Dwijen Rangnekar

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Letters

Damming the Theun River

In her article about the Theun Hinboun Hydropower Project in Laos (May/June 1996), Ann Danaiya Usher gives a somewhat biased and misleading impression of the situation.

She claims that as a consequence of the project more than 5,000 people "may lose their seasonal agricultural land and rich fisheries and may therefore have to move".

This is the kind of propaganda claim that might make a sensational headline, but has no basis in reality. While it is true that the reservoir will extend some 20 kilometres along the Theun and 14 kilometres along the Gnouang, Ms Usher neglects to mention that this "reservoir" will be confined to the natural river beds (this is why the project is labelled "run-of-the-river"), and that therefore no existing rice fields (swidden or paddy) will be inundated.

Nobody to my knowledge has made the absurd suggestion that the project would force a large number, let alone the entire 5,000 people of the area, to move.

When turning to the report of the social anthropological study I did for Norconsult as part of its Environmental Impact Assessment, Ms Usher imputes to me the rather bizarre view that the area has "no cultural significance". These words are not a direct quote from anywhere in the report. I stated that there was little likelihood that any culturally or archaeologically significant places would be disrupted by the project. In that sense the area does not contain remains of an "ancient culture", but what I found — and what I described in some detail in the report — was an example of a quite vigorous contemporary culture, the bearers of which, however, faced severe problems of adequate means of subsistence since they had to rely mainly on swidden cultivation. Both anthropologists and the people in the area are well aware that swidden cultivation is much less productive and much more labour demanding than paddy (wet-rice) cultivation, and the declared wish of most of the swiddeners in the area was to acquire paddy land and better skills to cultivate it. This is why I stated that "there are no sacred values inherent in swidden cultivation that should not be superseded by considerations of basic short term and long term food security". My point was that swidden and paddy cultivation are two alternative agricultural techniques that do not entail two different sets of cosmological ideas, beliefs and values; and that by opting for the more efficient and ecologically sustainable of these techniques (paddy cultivation) one does not violate any indigenous cultural values. As an added benefit, the promotion of paddy cultivation reduces the need to cut new forest for swidden fields. I thus recommended that paddy land be developed in the Nam Hai plain and that people along the Nam Theun should be encouraged to move into that area.

To portray these recommendations as "extraordinary" and the subject of "unanimous criticism", Ms Usher has ignored the results of the subsequent anthropological study, carried out for Norplan by anthropologist Stephen Sparkes of the University of Oslo. Sparkes's conclusions are essentially similar to mine. He, too, pointed out that swidden cultivation in the area was no longer an ecologically sustainable proposition; that it requires more time and energy compared to paddy cultivation; and that it therefore "limits the chances for economic advancement and diversity". He argued, exactly as I had done, for the development of paddy land, the appointment of agricultural advisers, establishment of irrigation schemes, and electrification of the villages in the plain.

It is a pity that Ms Usher has chosen to present a skewed picture of the situation because it diminishes the credibility of her arguments in a discussion which deserves serious attention. I would never claim that hydropower is without social and ecological problems, but I believe that discussions should be directed towards the best possible solutions of these problems rather than a utopian plea for the wholesale rejection of hydropower development. Ms Usher argues that Scandinavian hydropower engineers now deploy their skills abroad because they are no longer permitted to do so at home. This may be so, but who are we — who have long since acquired the benefits of electricity, reasonable educational and health facilities for ourselves — to blame people in other countries for striving towards these goals? Though hydropower projects in Laos are mainly geared towards export of electricity, they normally entail electrification of the project areas. The benefits of local electrification — the possibilities for pumped water, irrigation, refrigeration, rice mills, lighting, television and so on — should not be underestimated; such facilities significantly diminish the workload of women in particular. Electrification also means that people do not have to rely for lighting on car batteries that may eventually be discarded in the bush. Whether or not we sympathize with the political ideology of the Lao regime, the fact remains that a legitimate government has decided to use one of the country's main assets, hydropower, for acquiring foreign exchange and for domestic social and economic development. Or are the party comrades in Vientiane just being screwed by multinational profit capitalism? Timber being the second of Laos's major assets, would it be ecologically and socially better for the government to seek foreign revenue from excessive logging? We may deplore, as Ms Usher does, that the present political climate in Laos is not conducive to "critical debate on the ecological and social costs of large dams" (or even small dams like Theun Hinboun). There is thus all the more reason that debates abroad should not be marred by dishonest journalism.

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Ann Usher replies . . .

Theun Hinboun, on the judgement of anthropologist Jan Ovesen, has been characterized by its builders and its Nordic aid financiers as a dam that has no negative consequences for local populations and requires no resettlement of local people. On close examination, both of these claims are questionable.

In 1993, Mr Ovesen wrote, "I have been unable to detect any ways in which the project could adversely affect any of the population groups in the area." Given the shortcomings of the environmental review up to that time, there appears to be little basis for making such a statement.

Notwithstanding the conclusions of the review, the Theun Hinboun dam is likely to degrade the resource base of subsistence communities, principally by destroying

fisheries upstream and downstream on which people are dependent for protein and income, and by flooding their seasonal agricultural land, which provides important nutritional supplements to daily fish and rice.

At the same time, various pressures are forcing farmers to reduce fallow periods, which undermines the sustainability of the swidden system.

In such a context, the dam could threaten the food security of local people who are already very poor. If they can no longer make a living in the area, they may have to move away.

Thus, Mr Ovesen and I agree that some people in the Theun river valley may move as a result of the construction of the Theun Hinboun dam. However, he suggests that people would be "encouraged" (by whom? by what?) to abandon their swidden farms and move to the Nam Hai valley to set up paddy fields there.

One simply cannot argue, on the one hand, that there will be no resettlement from Theun Hinboun and, on the other, claim that migration from the area is an "added benefit" of the project. Leaving aside the swidden-versus-paddy debate (which is far from resolved), the record of moving hill people in the lowlands in Laos and Thailand has been dismal. It is irresponsible for an anthropologist to advocate such migration, and then to count this as a positive impact of the dam.

Eco-Taxes

Ed Mayo's "The Potential of Ecotaxes" (*The Ecologist*, Sept/Oct 1996) is one of several recent proposals to move taxes from employers' payrolls of insurance contributions to the use of resources. It is not clear that such a transfer will aid sustainability.

"The polluter pays" sounds an attractively fair proposal. But much of the tax will be passed on in the form of higher prices, eventually being paid by the person who cannot pass it on — the consumer. The distribution of tax between polluter and consumer will depend on the elasticity of demand for the polluting product. The tax on products with low elasticity, such as petrol, will be largely borne by consumers, either directly or by paying higher transport costs or bus fares. The tax will be borne by everyone, rather like an increase in VAT.

It is hoped that relieving employers of national insurance contributions will create more jobs. Is there any reason to suppose that employers will use the money gained from reduced costs to employ more workers? Is not the money more likely to go into higher salaries and dividends, like the money gained by sacking workers over the last decade?

Taxing resource-use and relieving employers of insurance costs will add to everyone's tax burden, for which only employers will be compensated. It would be a regressive change, adding to the redistribution of wealth from the poor to the rich which has been such a noticeable feature of the last 10-20 years. Surely eco-taxes must not take us further down this road?

Peter Holway
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DIARY DATES

20 February 1997: **BIOTECHNOLOGY AND REGULATION**, Gulbenkian Lecture Theatre, St Cross Building, St Cross Rd, Oxford. 5 pm. For details, contact Anne Maclachlan, OCEES, Mansfield College, Oxford OX1 3TF. Tel/Fax: 01865 270886; E-Mail: ocees@mansfield.oxford.ac.uk

6 March 1997 **BUSINESS STRATEGY AND ENVIRONMENTAL POLICY**. Details as above.

20-22 March 1997: **HEALTHY AND SUSTAINABLE COMMUNITIES CONFERENCE**, Sheraton Colony Square Hotel, Atlanta, Georgia, USA. For more information, contact Dr Robert Bullard, Environmental Justice Resource Center, Clark Atlanta University, 223 JP Brawley Drive SW, Atlanta, GA 30314. Tel: +1 (404) 880 6911; Fax: +1 (404) 880 6909.

22 March 1997: **SUSTAINABILITY: THE ETHICAL CHALLENGES & PROSPECTS FOR ECOLOGICAL POLITICS AFTER THE ELECTION**, Friends' Meeting House, 173 Euston Rd, London. 10.30am. For more information, contact The Campaign for Political Ecology, 42 Rose Terrace, Horsforth, Leeds, LS18 4QA. Tel: 0113 259 0812; web site: http://www.gn.apc.org/eco

22-23 March 1997: **ISLAM, HUMAN RIGHTS AND REFUGEES.** Queen Elizabeth House, University of Oxford. For details of this and other seminars and courses, contact The Coordinator, Education Unit, Refugee Studies Programme, Queen Elizabeth House, 21 St Giles, Oxford OX1 3LA. Tel: 01865 270723; Fax 01865 270721; E-Mail: rspedu@ermine.ox.ac.uk

26-27 April 1997: **NATURAL HEALTH AND ECOLOGY SHOW**, Pittville Pump Rooms, Cheltenham. Encompassing all aspects of natural health and positive attitudes towards the environment. For details of this event and others throughout the UK, contact *Creativity*, 33 Beechmount Drive, Weston Super Mare, Somerset, BS24 9EY. Tel/Fax: 01934 813407.

28 April-2 May 1997: **TRAFFIC & TRANSPORT ISSUES IN EUROPE**, Zürich. Contact Peter Bauer, Rennweg 8, CH-8001 Zürich, SWITZERLAND. E-mail: borninborn@uns.umnw.ethz.ch

12-16 May 1997: **INTERNATIONAL CONFERENCE ON THE SCIENCE AND MANAGEMENT OF PROTECTED AREAS (SAMPA III)**. University of Calgary, CANADA. Contact Patricia Benson, 552, 220 4th Avenue SE, Calgary, Alberta, CANADA T2G 4XE. Tel: +1 (403) 292 4519; Fax: +1 (403) 292 4404; E-Mail: sampa3@pch.gc.ca

19-21 June 1997: **THE GOALS OF MEDICINE: Priorities for the Future**, Palazzo Serra di Cassano, Naples, ITALY. Further information from Naples Goals Conference, The Hastings Center, 255 Elm Road, Briarcliff Manor, New York 10510, USA.

15-18 October 1997: **LOCAL AND GLOBAL COMMUNITIES: COMPLEXITY & RESPONSIBILITY**, Bar Harbor, Maine, USA. For information, contact Dr Melville Cote, Society for Human Ecology, College of the Atlantic, 105 Eden Street, Bar Harbor, Maine 04609, USA. Fax: +1 (207) 288 4126; E-Mail sheconference@ecology.coa.edu

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