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www.econexus.info
info@econexus.info

Hungry Corporations:

Transnational Biotech Companies Colonise the Food Chain

By Helena Paul and Ricarda Steinbrecher
with Devlin Kuyek and Lucy Michaels

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Chapter 5:

The Main International Players and Corporate Influence

Most of the world still lacks national laws to deal with genetically engineered organisms, therefore we need strong international regulation to protect these countries and biodiversity from genetic pollution.

Louise Gale, lawyer and Greenpeace political adviser, 1999[1]

Whatever the intentions of the various international bodies – and many of them announce that they are committed to eradicating poverty – the fact is that there has actually been a net flow of resources, including funds and genetic material, from South to North over the last 50 years. The Bretton Woods institutions established after the Second World War (The International Bank for Reconstruction and Development, more commonly named the World Bank; the International Monetary Fund; and the General Agreement on Tariffs and Trade, now the World Trade Organisation – see Chapter 2) were ostensibly set up to aid post-war reconstruction and to build global economic prosperity. However, they have actually been instrumental in opening up economies and access to raw materials for the transnationals, whose interests now dominate the agenda of the World Trade Organisation. The United Nations institutions have also shown themselves vulnerable to corporate delegations and tend to promote regulation which serves corporate interests.

Corporate interests also have an increasing grip on research, partly because the amounts of public funding available for such activities have dwindled, often in obedience to the structural adjustment policies of the finance institutions. In these circumstances, TNCs can often gain influence over the whole research agenda by merely topping up funds with a small proportion of the total. The universities then provide cheap research and apparently 'independent' advocates for corporate interests.

Biotech corporations have carefully cultivated strong relations with government and the public research sector. They appear to have persuaded some governments (including those in the UK, the US, Australia and Canada) that biotechnology represents the next industrial revolution and is essential for competitiveness. Such governments have boosted public sector funding of the biotech industry. Corporate lobbying has led to, amongst others:

- legislation favourable to industry and positive testing of GM products;
- omission of a 'precautionary principle';
- insufficient sanctions for corporate misdeeds;
- massive channelling of public money to the biotech industry;
- research diverted towards profitable applications of GM technology;
- GM crops being dumped on the global South as food and humanitarian aid.

These developments are promoting the rapid, unchecked and under-regulated spread of GM technology and GM crops around the world.

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5.1 The World Bank

> *They no longer use bullets and rope. They use the World Bank and the IMF.*
>
> Jesse Jackson addressing eleven African heads of state, Libreville, 27 May 1993[2]

The World Bank was set up in 1944 to provide loans for post-war reconstruction and consists of five closely associated institutions:

- the International Bank for Reconstruction and Development (IBRD);
- the International Development Association (IDA);
- the International Finance Corporation (IFC);
- the Multilateral Investment Guarantee Agency (MIGA);
- the International Centre for Settlement of Investment Disputes (ICSID).

Although the Bank claims that 'Our dream is a world free of poverty',[3] the economist David Korten, former adviser to USAID, writes:

> If measured by contributions to improving the lives of people or strengthening the institutions of democratic governance, the World Bank and the IMF have been disastrous failures – imposing an enormous burden on the world's poor and seriously impeding their development. In terms of fulfilling the mandates set for them by their original architects – advancing economic globalisation under the domination of the economically powerful – they both have been a resounding success.'[4]

Korten later adds: 'They have arguably done more harm to more people than any other pair of non-military institutions in history.'

On its own website, the Bank proclaims:

> The World Bank is owned by 183 member countries whose views and interests are represented by a Board of Governors and a Washington-based Board of Directors.… Under the Articles of Agreement of IBRD, to become a member of the Bank a country must first join the International Monetary Fund (IMF). Membership in IDA, IFC and MIGA are conditional on membership in IBRD. … Member countries are shareholders who carry ultimate decision-making power in the World Bank.

The Bank's internal operating process is so secretive 'that access to many of its most important documents relating to country plans, strategies and priorities is denied to even its own governing executive directors'.[5] In practice the Bank's agenda is set by those countries that have invested most money in it. These are the United States, the United Kingdom, Japan, Germany and France.

The World Bank was a major promoter of the green revolution, funding fertilisers, herbicides, insecticides, irrigation and machinery for Southern countries, to go along with high response variety/high yield variety (HRV, HYV) seeds. Although grain yields increased, there were massive costs in terms of loss of locally adapted farmer varieties, destruction of the soil and the creation of multiple dependencies – the new HRV seeds depended on packages of inputs and the farmers became indebted. Even the Bank admits:

> Large-scale farmers generally acquire knowledge of such technologies more quickly and because they have better access to the working capital needed to utilise these technologies more fully, they capture the earliest and largest gains from innovation …. At least in the short run, relative distribution of income worsens as between large-scale and small-holder farmers.[6]

Many observers fear that genetic engineering biotechnology will merely continue and even accelerate the trend towards inequitable distribution of resources and entitlements and lead to even further loss of farmer varieties. Moreover, studies show that other types of innovation, such as intercropping or variety mixes, can produce much better results: doubling yields without the use of costly, synthetic inputs.[7]

In an article published in *Nature* (2000), M. S. Wolfe explained that while fertiliser and pesticide use is expensive and may cause new problems, variety mixes have been shown to work. He continues:

> Mixtures of species provide another layer of crop diversity, with half-forgotten advantages waiting to be exploited in contemporary approaches. It is widely recognised, for example, that high-yielding mixtures of grains and legumes (grass plus clover, maize plus beans, and many other combinations) can restrict the spread of diseases, pests and weeds. At the same time, such mixtures can provide near-complete nutrition for animals and humans alike, without recourse to expensive and uncertain forays into genetic engineering.[8]

Questioning the Bank's achievements

The Centre for Economic and Policy Research (CEPR) is a US-based public interest group dedicated to promoting democratic debate. In their papers 'The Scorecard on Globalization, 1980–2000, Twenty Years of Diminished Progress' and 'Growth May Be Good for the Poor but Are IMF and World Bank Policies Good for Growth?'[9] The CEPR shows that the World Bank and the IMF have failed to improve life for the poor in the last 20 years.

Using standard indicators like economic growth, life expectancy, infant mortality, education and literacy, the CEPR reveals that progress has slowed down between 1980 and 2000 compared with the period 1960–80. The average Mexican and Brazilian would have almost twice as much income if the rate of improvement in 1960–80 had been maintained.

They also show that, regardless of whether growth is good for the poor, the World Bank and IMF policies of trade liberalisation, privatisation, export promotion and cuts in government spending are failing to deliver even the promised economic growth. Moreover, they question the notion that the poor benefit from economic growth in itself. They call for a radical examination of the power of these institutions to carry on imposing failed economic models on the developing world.

The Bank and the seed sector in Africa – ISSSSA

In April 1999 the World Bank announced its Initiative For Sustainable Seed Supply Systems in Africa: Sub-regional Action Plan in Southern Africa. The Action Plan is designed to be implemented in Malawi, Mozambique, Zambia and Zimbabwe, as pilot countries in the Southern Africa region. National aspects are to be funded through currently ongoing World Bank and/or joint-donor-financed projects for agricultural and rural development: examples include the Agricultural Services and Management project in Zimbabwe, the Agricultural Services Project in Malawi and so-called Agricultural Sector Investment Programmes in both Zambia and Mozambique. The stated aim of the project is to harmonise seed-related regulation, improve competition and commercial development, and to promote the entry of 'improved varieties' with international involvement. There are key words in the Action Plan guaranteed to arouse the distrust of those who work to protect biodiversity and farmers.

> Often a major constraint is national legislation that limits entry of improved varieties, constrains competition, restricts multinational involvement in African seed systems, and inhibits development of domestic seed companies. Restricting commercial development has also inhibited the formation of seed trade associations, which could provide substantial benefits to the African seed sector. Seed associations – open to public and private seed company membership – serve to lobby and influence governments, exchange information, and generally to ease barriers to efficient seed production and marketing and to the effective transfer of improved varieties.[10]

In the proposed outline for the Sub-regional Action Plan, the World Bank further states:

> This Action Plan is launched to analyse in more detail the challenges faced by seed sectors in the countries of Southern Africa region and to make a significant contribution to the exchange of information, debate, and dialogue between representatives from African governments, donors, seed companies, farmers' organisations and other associations pursuing national seed sub-sector strengthening, the harmonisation of seed regulatory frameworks and the development of regionally competitive seed supply systems in Africa.[11]

The African Seed Trade Organisation was founded in 1999 and in the following year the African Seed Network was launched. Both are highlighting the need to improve seed supply systems. While the first is to represent the interest of the seed trade, the African Seed Network is working more directly with farmers and claims that 'Seed supply systems in sub-Saharan Africa, particularly among small-scale farmers, are set to improve with the launch of the African Seed Network.' The Network is funded by the FAO (see Chapter 6), from which it derives policy guidance. The Network's views are in line with the other ongoing activities, such as the World Bank initiative and the activities of seed-trading organisations. The Network has stated:

> The unavailability of seed production technology in many African countries, lack of seed rules regulations and defining seed standards, phytosanitary requirements, protection of intellectual property and differences in seed rules were noted as some of the impediments to increasing the range and quality of seeds available to sub-Saharan farmers.[12]

There is growing fear among NGOs such as Genetic Resources Action International (GRAIN) that the current World Bank initiative, combined with pressures to adopt the most recent version of UPOV (Union for the Protection of New Varieties of Plants) will lead to a corporate takeover of the seed sector in Africa. UPOV sets out a regime to protect the interests of plant breeders. Until recently it had few members among Southern countries, but this is rapidly changing. These countries are being told that 'patents and other forms of IPR (intellectual property rights) are the key to attracting investment in biotechnology, which will uplift their economies and improve food security'. Africa's seed supply system could suffer the same fate as Europe's, with the outlawing of farmer varieties that do not fit the industrial criteria of being distinct, uniform and stable, and the imposition of F1 hybrids that do not breed true when saved for planting, driving the farmer back to the (increasingly corporate) seed salesman each year. It could also facilitate the entry of technology to prevent the replanting of saved seed through Terminator technology and other genetic use restriction technologies (GURTs). This would take the development of agriculture out of the hands of the African farmer.

The Bank, agrochemicals and genetic engineering

The Bank is reported to have financed US$250.75 million worth of pesticides in 1988–95. In 1993–5 alone, $56.9 million went to producers in G7 countries (see Table 5.1).

Two of the Pesticide Action Network's 'Dirty Dozen' pesticides also appear in these contracts: paraquat and DDT. Contracts to French and German companies supported the procurement of almost US$120,000 of paraquat for two World Bank projects in Nigeria.[13]

GRAIN draws attention to the fact that by 1996, according to a US Treasury report,

> in just two years (1993 to 1995), the World Bank and other multinational development banks had channelled nearly $5 billion to US firms. One major beneficiary was Cargill, the third largest food corporation in the world. Cargill's 1995–6 sales were a mind-boggling $56 billion, which is roughly equivalent to the GNP of Pakistan, Venezuela or the Philippines. Company earnings reached almost $1 billion and profits were 34 per cent higher than the previous year. These are hardly credentials we would expect to qualify for World Bank assistance, nor does it seem like a wise investment for the Bank.

GRAIN speaks here for angry farmers in poor countries everywhere:

> Judging from the reaction of rural people around the world, supporting Cargill's operations does little to meet the World Bank's vision for rural development. The heated demonstrations against the company in 1992 attended by thousands of India's farmers (the very people the Bank is aiming to help) attest to the inappropriateness of entrusting agricultural development to agribusiness giants. The farmers were angry about the false promises made by the company of higher yields by switching to Cargill seeds, the environmental damage caused by the chemical packages required, the threat to agrobiodiversity posed by monocultures, and being robbed of their intellectual property.[14]

The World Bank has already provided hundreds of millions of dollars to develop biotechnology in countries such as Kenya, Zimbabwe, Indonesia, and Mexico. Doyle and Persley comment:

> The World Bank has lent at least US$100 million for biotechnology-related activities, while bilateral development agencies, such as those of the USA, the UK and the Netherlands, and private foundations such as the Rockefeller Foundation, have invested approximately US$200 million in biotechnology R&D over the past decade. CGIAR centres presently spend approximately US$22.4 million per year on biotechnology R&D for crops and livestock important throughout the developing world.[15]

In its 1999 Annual Report, the World Bank claims that

> biotechnology offers another option for increasing crop yields on less land. Advances in biotechnology are progressing rapidly in industrial countries, but few commercial applications exist for developing countries. Still, biotechnology holds promise for the latter in their efforts to increase productivity, conserve natural resources (especially biodiversity), and alleviate poverty.[16]

In December 2000, the World Bank met with 13 major players, including many of the largest agrochemicals

Table 5.1: How the World Bank finances G7 pesticide producers

Funds acquired (%)	Country	Corporation	US$ million	Ranking according to funding
38	France	Rhone Poulenc	18.6 (=33%)	1
		Roussel Uclaf	1-3	4
27	Germany	BASF	6.6	2
		Bayer	1-3	4
		Air Lloyd	1-3	4
		Hoechst	1-3	4
15	UK	Zeneca	> 3	3
11	US	FMC Corp	> 3	3
		Cyanamid	1-3	4
10	Japan	Sumitomo	> 3	3

companies: Aventis, BASF, Bayer, Cargill, Dow, DuPont, Emergent Genetics, Mahyco, Merial Limited, Monsanto, Rockefeller Foundation, Seminis, and Syngenta. The goal of the meeting was to get private sector perspectives on how to increase food security and agricultural productivity in an environmentally and socially sustainable manner.[17] This meeting stated that 'agricultural science and research, not limited to, but including biotechnology, is a key component in addressing food security'. It also candidly acknowledged that

> Presently, much of the world's agricultural research, particularly in biotechnology, is done by the private sector. In order to successfully continue working in this area, private companies must provide shareholder returns. As a result, they are not likely to meet most of the developing countries' agricultural research needs.

Along with funding the FAO and public scientific research institutions such as the CGIAR, the World Bank has funded public–private institutions to promote biotechnology in the South such as the International Service for the Acquisition of Agri-biotech Applications (ISAAA).

Partnerships with agribusiness

Agribusiness regularly take parts in the World Bank/corporate staff exchange programme or 'Share'. Started by World Bank President James Wolfensohn in 1995, the Share programme is, according to Wolfensohn, intended to 'foster closer partnerships with external organizations, particularly the private sector, so as to introduce fresh perspectives and new approaches to deliver better services to our clients'. Companies involved include Dow, Aventis and Syngenta.[18]

5.2 The Consultative Group for International Agricultural Research (CGIAR)

> *The CGIAR challenge is to create a new form of public–private partnership that will protect intellectual property while bringing the benefit of this research to the poorest nations.*
>
> CGIAR Review, 1998

The CGIAR's recent history encapsulates the wider struggle for control over genetic resources, which is critical for the future of agriculture and the seeds that underpin it. This is why considerable space is being given to it here. This struggle can be expressed in terms of two opposing movements. On the one hand there are those who call for a bottom-up approach starting with farmers and basing research on their knowledge, with wide civil society participation, taking into account the true complexity of the issues, working in the public domain for the common interest. On the other hand there is the top-down imposition of solutions produced by scientists behind desks or in laboratories, often owned by private companies – solutions increasingly composed of genetically engineered seeds protected by patents. The former approach favours decentralisation and a more regional process that will make it easier for the farmer to participate, while the latter favours centralisation. The key issue is the fate of the germplasm (genetic resources, for example in the form of seeds) developed, shared and safeguarded over millennia by farmers.

It is this germplasm which forms the basis of the global food supply. It is therefore vitally important and yet it generally draws little public attention in the North where people are already alienated from the real source of their food. Urbanisation has resulted in a widening gulf between food producers and consumers. Contempt among urbanites for those who get their hands dirty – soiled – in the earth means that farmers are held in low esteem. Ignorance makes people easy to manipulate, yet many sense the importance of the issue and the conflict around it.

The struggle continues, both inside the CGIAR and outside. The effect inside the organisation is to make it somewhat schizophrenic in its approach. Some sections participate in projects to promote bottom-up, farmer-based solutions while other sections participate in projects that are opposed to this, often promoting biotech and high-tech solutions. Farmer organisations and NGOs have lobbied passionately and tirelessly against this emphasis, yet they seldom get a sympathetic hearing.

The set-up of the CGIAR

The CGIAR's mission, as set out on its website,[19] is to contribute to food security and poverty eradication in developing countries through research, partnership, capacity building and policy support. The CGIAR was established in 1971 by the World Bank and the FAO with the help of the Rockefeller and Ford foundations. Eighteen governments and organisations attended as members, plus ten as observers, but none of them were from developing countries.

The CGIAR is an informal association of 58 public and private sector members, including private foundations, international development agencies and 50 governments, mainly from the North. They support a network of 16 international agricultural research centres, which now call themselves the Future Harvest Centres[20] and which have more than 8,500 scientists and support staff working in more than 100 countries.[21] In 2000, contributions from CGIAR members amounted to $331 million, making up its budget. Industrial countries, specifically the members of the Development Assistance Committee of the Organisation for Economic Cooperation and Development (OECD), account for more than two-thirds of CGIAR financing. The CGIAR is always short of funds. The Global Conservation Trust was launched in Johannesburg at the World Summit on Sustainable Development in September 2002. It is a public–private partnership initiative which aims to raise $260 million of extra funding to protect genetic resources. The CGIAR and the FAO are involved, as are the Gatsby Charitable Foundation, one of the Sainsbury family trusts, USAID,[22] Glaxo and Syngenta.[23]

The World Bank, the FAO and the United Nations Development Programme (UNDP) are co-sponsors of the CGIAR. The Novartis Foundation is a CGIAR partner and the Syngenta Foundation was accepted as a member in 2002 (see Chapter 8 for more on these two foundations). Links with the World Bank have been close from the beginning. The CGIAR's chairperson is a vice-president of the World Bank, where its secretariat is based and from which it also receives funding. For instance, Ian Johnson, who became chairperson of the CGIAR in July 2000, was at the same time the World Bank President for Environmentally and Socially Sustainable Development. He helped found the Global Environment Facility of the World Bank in 1991 – a joint project of UNDP, the United Nations Environment Programme (UNEP) and the World Bank.

International agricultural research centres (IARCs)

The network of 16 international agricultural research centres (IARCs) ('Future Harvest Centres') around the world currently overseen by the CGIAR include:

- the International Maize and Wheat Improvement Centre (CIMMYT) in Mexico;
- the International Rice Research Institute (IRRI) in the Philippines;
- the International Centre for Tropical Agriculture (CIAT) in Colombia;
- the International Food Policy Research Institute (IFPRI) in Washington;
- the International Potato Centre (CIP) in Lima, Peru;
- the International Centre for Agricultural Research in Dry Areas (ICARDA) in Aleppo in Syria;
- the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Hyderabad, India.

At the CGIAR, most decisions for the world's largest and most influential agricultural research projects have been made by a small number of white Northern men from a handful of agricultural colleges in Australia, Canada, Britain and the US, with no internal or external rules of governance. Since 1997, the CGIAR has attempted to redress this balance by filling more of the trustee posts with persons from the South and with women.[24]

The struggle for the heart of the CGIAR

In 1995, noting that it had been 14 years since the previous review of the CGIAR, NGOs called for a new review, focusing on bottom-up strategies for food security and livelihood systems, with the full participation of the South, not just confined to the IARCs. The results of the ensuing Third System-Wide Review were announced in October 1998. The review document, which contained language that openly promoted biotechnology and patenting, proposing what it termed an 'integrated gene management' approach, also proposed a central body for the system. This was rejected by the CGIAR members, while both suggestions were strongly resisted by NGOs and farmer organisations, and were dropped. A consultative council was established to draft CGIAR policy. The next attempt to find a direction for the CGIAR was undertaken by the Technical Advisory Committee (TAC), which presented its 'vision and strategy' at the CGIAR's mid-term meeting in May 2000 in Dresden. The vision called for a more regional approach, with a focus on Africa and South Asia.

At the same time, there was a meeting of the Global Forum on Agricultural Research (GFAR), partly spawned by the CGIAR. The CGIAR's budget only

covers 4 per cent of agricultural research; 96 per cent is carried out by national agricultural research institutes, universities and (increasingly) corporations. It was therefore proposed that all those involved in agricultural research should be part of a global forum that would help to decide the priorities of the CGIAR. But the usual struggle began here too between proponents of top-down technological solutions, focusing on GM and IPR in liberalised markets, and those who sought bottom-up, farmer-based, participatory solutions. However, the statement from GFAR promoted solutions based on genetic engineering and market liberalisation rather than addressing fundamental problems of landlessness and access to resources. The 'global shared vision' produced by GFAR was therefore not shared by farmers groups and NGOs.

A Change Design and Management Team (CDMT) was set up within the CGIAR in 2000 to implement change, but the struggle between regionalism and centralisation continues, with some NGOs pointing out how shifting the governance of agricultural research to the different regions and away from the IARCs could reduce costs as well as improving the participation of farmers. The CDMT proposed a series of multi-centre 'challenge programmes' to give renewed energy and direction to research and shift from programmes focused on single centres towards multi-centre collaborations. This was adopted but there is disappointment amongst farmers and NGOs that major programmes adopted to date are on functional genomics and bio-fortification (food enhanced with vitamins and minerals), thus implying a strong role for biotechnology.

At the end of November 2002 the NGO Committee of the CGIAR indicated its disappointment with the CGIAR for embracing GM; for failing to call for a moratorium, especially in areas of origin of key crops such as maize in Mexico; and for failing to uphold the principle of the CGIAR that all genetic resources should be in the public domain. It said that it would review the CGIAR during 2003 and for that period of time would 'freeze' its relationship with it.[25] Meanwhile GRAIN and other NGOs have published assessments and critiques of the relationship between the CGIAR and farmers in poor countries.[26]

Benefits flow north

A major role of the CGIAR is to collect samples of germplasm from all over the world and to preserve them for humanity. Although many commentators point out that the most effective conservation is carried out *in situ* – that is, in the field, responding to evolutionary pressures, climate change and other factors – most of the collected samples are actually preserved in gene banks *ex situ*, where they may lose their capacity to germinate.

> [N]inety-one per cent of all the samples collected and distributed came from Asia, Africa and Latin America. Despite this only 15 per cent of these samples have so far gone to developing nations. Eighty-five per cent were distributed more or less equally among the northern-influenced IARCs and the industrialised countries themselves. The United States swallowed the lion's share with more than a quarter of all the samples.[27]

There is a great deal of evidence that the true beneficiaries of the CGIAR, both financially and in terms of germplasm, are the Northern industrialised countries. Their returns on their investment in the CGIAR can be substantial:

> Although the CGIAR's stated mandate is to increase food production in the South, the work of the IARCs has substantially benefited agricultural development in the North as well.
>
> Consider the US wheat crop. According to a 1996 study by one of the CGIAR'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.[28]

In a letter to the US senate in 1994, then Secretary of State Warren Christopher and two Cabinet colleagues argued that foreign germplasm contributed $10.2 billion annually to the US maize and soybean crop.[29]

Since 1974, according to a study funded by Australian and international agricultural research agencies, Australia's wheat industry has gained more than US $3 billion as a result of more than 50 durum wheat varieties provided by CIMMYT – the CG Centre based in Mexico. Between 1972 and 1996, the Australian Government contributed a grand total of US$80.1 million to the Consultative Group on International Agricultural Research.[30]

Corporate beneficiaries – privatising the germplasm heritage

> *In recent years [prior to 1996], 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. Pioneer Hi-Bred obtained hybrid maize from the Nigerian IITA [International Institute of Tropical Agriculture] centre, the product of research financed directly by the Nigerian government, and is now marketing it from Zimbabwe to Thailand. Cargill, meanwhile, is commercialising IITA's inbred maize lines in East Africa and Asia. At least four CGIAR varieties are 'protected' in the US or Europe under a plant-specific form of patent.*[31]

Arguments over whether patents should be allowed on CGIAR resources have continued for many years inside and outside the organisation. The issue of Terminator technologies (see Chapter 8) aroused such strong resistance that in October 1998, the CGIAR banned them from breeding materials. After a long campaign by organisations including RAFI (now the ETC group) and GRAIN, the CGIAR has taken a position on intellectual property that seems fairly clear:

> The terms of the agreements signed between the FAO and CGIAR Centres, stipulate that the germplasm within the in-trust collections will be made available without restriction to researchers around the world, on the understanding that no intellectual property protection is to be applied to the material.[32]

However, the reality is more complex. In 1994 the contents of the major gene banks were placed under the auspices of the FAO in a trusteeship agreement designed to protect them from biopiracy. The CGIAR holds only about 10 per cent of the 6 million genebank accessions, mostly collected during the 1960s, but its collection is crucial because it is well documented and preserved. According to its website,

> The CGIAR holds one of the world's largest *ex situ* collections of plant genetic resources in trust for the world community. It contains over 500,000 accessions of more than 3,000 crop, forage, and agroforestry species. The collection includes farmers' varieties and improved varieties and, in substantial measure, the wild species from which those varieties were created.[33]

The *Ecologist* estimates that the CGIAR holds about 40 per cent of the unique farmer-bred varieties worldwide. This germplasm is vital for crop breeding globally.

There are three parts to the trusteeship system: the FAO–CGIAR Agreement, the joint FAO–CGIAR Statement and a model Material Transfer Agreement (MTA). Under the FAO–CGIAR Agreement, germplasm is to be held in trust for humanity, to be freely available (in the public domain), and not to be patented. All this sounds very laudable. However, the MTA says germplasm must not be patented 'in the form received', which could leave the way open for patenting anything derived from the germplasm that is sufficiently different from the original, and anything which is genetically engineered. Moreover, there is no obligation to monitor whether or not the material is later patented by the recipient. Under the Agreement, 60,000 samples of germplasm were transferred during 2000. This material may be commercialised, but there is no mechanism for transferring any benefits to those who originally developed it. Ironically, perhaps, the fact that the material is in the public domain makes it impossible for those (small farmers, local communities and indigenous people) who developed it to claim rights over it, including decisions as to how it is used and by whom.

The latest development is that the FAO Treaty on Plant Genetic Resources, which to date covers just 35 food crops and 29 forage crops, will soon govern the 'in trust' germplasm under its own provisions. This treaty contains those same words: patenting of germplasm is forbidden *in the form received*. The struggle over how these words are to be interpreted, whether material derived from the germbank may be patented, and, more broadly, who benefits from genetic resources, continues unabated. Other ambiguities remain in the Treaty. There may be a glimmer of hope in the fact that although farmers' rights are not recognised in the Trusteeship Agreement, Article 9 of the Treaty is devoted to them.

In the end, the truth of the matter is that the interests of the two main strands struggling within the organisation, independent farmers with their supporters and the corporations with their backers, are actually irreconcilable, in spite of constant efforts to suggest that they could be mutual.[34]

Genetic engineering: serving the corporate agenda

The struggle within the CGIAR over genetic engineering has been almost as intense as that over IPRs. A Private Sector Committee was set up in 1995 and there are two panels – the Panel on General Issues in Biotechnology and the Panel on Proprietary Science and Technology – which lobby within the organisation.[35] Although the Third System-Wide Review's recommendations for the CGIAR to develop a centralised legal entity to promote patenting and

Creeping contradictions: IPRs and the CGIAR system

The CGIAR centres and other international agricultural research centres have proven all too willing to concede to industry's IPR agenda in hopes of accessing new technologies for biotechnology and genomics. The International Maize and Wheat Improvement Centre (CIMMYT) was the first to go. Taking its cue from the recommendations of a dialogue with the private sector, CIMMYT announced a new intellectual property policy in April 2000, whereby it will selectively pursue its own IPR in order to 'defend' its research or to facilitate partnerships with industry.[36] Other research centres soon followed. In February 2001, the International Crops Research Institute for the Semi-Arid Tropics established an intellectual property policy that 'reserves to itself any and all IPR, without limitation, discovered or produced as a result of cooperation related to any research agreement'.[37] The International Livestock Research Institute (ILRI) in Kenya, which actively works in partnership with the private sector on transgenic technologies, takes a similar 'defensive' position. It states:

> ILRI recognises that IP protection on its products and technologies may be necessary: to ensure continued availability of germplasm, inventions publications and databases to ILRI clients and prevent them from being misappropriated by others for profit making; to ensure the delivery of improved products and technologies in developing countries; to negotiate access to other proprietary rights and technologies required for product development.…

It could be argued that the public research centres have resisted pressures for IPRs by adopting policies that, while accepting IPRs, try as much as possible to keep research in the public domain and give farmers access to new technologies. Generally, the IARCs claim that they will only take out IPRs or enter into research alliances involving IPRs when these are necessary to give developing countries access to important new technologies. But this argument loses sight of the bigger picture. The IARCs and their national counterparts hold tremendous influence over agricultural policy in Africa and by accepting IPRs on biodiversity, they legitimise them. As the World Bank points out, 'politicians can be loath to change seed regulations without support from at least some national experts, including crop scientists and other agricultural experts'.[38] IPRs will have dire consequences for the very people that public research is supposed to help. Rather than gradually caving into industry's IPR demands, it would be more appropriate for these institutions to recognise their critical position and join others taking a stand against the privatisation of agricultural biodiversity and public research.

Devlin Kuyek (2002)[39]

biotechnology and to go for public–private partnerships was rejected, it reveals the thinking of the pro-biotechnology lobby inside the organisation. As we have seen, the CGIAR has very little funding for research and relies on joint ventures with universities and/or private sector support in the form of cash and/or technology.[40] Corporations have financial resources far beyond the CGIAR's means. For example, in 1998 Novartis (now Syngenta) decided to invest $600 million over the following 10 years in the Novartis Agricultural Discovery Institute Inc. (NADII) in San Diego, California, a wholly owned entity of the Novartis Research Foundation. The initial investment was announced to be $250 million, representing 75 per cent of the CGIAR's entire annual budget.

On the other hand, the corporations recognise that the CGIAR can act as a broker and multiplier for them. Sam Dryden, chairperson of the CGIAR's Private Sector Committee, explained that according to the private sector 'the CGIAR can help corporations move into territories where agriculture has been traditionally served by the public sector'.[41]

When investigating the influence of private sector involvement on the CGIAR and its biotech agenda, Janet Bell reported:

> The CGIAR does not have a very good record of serving poor farmers around the world. Industry's influence is likely to make it even less responsive to their needs and shift it back towards its technology focus and cash crop agenda. Henry Gorrisma of the Dutch government suggests that, 'The private sector may have a role to play in agricultural research, but the CGIAR is trying too hard to get it on board.' To this end, Gorrisma suggests, it is reorienting its research direction, at the expense of losing sight of its mandate and the poor. 'It is easy for industry to sway the CGIAR,' Gorrisma adds. 'It does not have to put up much money to exert a great deal of influence.'[42]

So far, most of industry's involvement with the CGIAR has been limited to the donation of genes and technologies. TNCs have increasingly allowed agricultural research centres as well as national agricultural research stations to access 'for free' the traits, cell lines, products and processes that they have patented. 'Monsanto has collaborative projects with CIMMYT and with the CIP, while Novartis has links with IRRI and AgrEvo with the CIP and ICARDA. In all cases, the companies donated genes and some technologies, but little direct funding appears to have been given.'[43] For example, Novartis has licensed the use of its proprietary technologies for cassava and for Bt in rice to certain IARCs free of charge on certain conditions.

In exchange, the corporations gain from access to the CGIAR gene and seed banks. Warnings were already given in 1990 by Cary Fowler and Pat Mooney:

> The danger – now being recognised by the IARCs – is that they will be relegated to the role of doing basic research for the benefit of private companies. The companies can take IARC material and exploit it for their own commercial purposes.[44]

The CGIAR is therefore often caught up as a participant in projects which it serves without having any real control over them and to which it brings valuable germplasm resources which could end up as 'feedstock for the biotechnology industry' as the Biotechnology Advisory Center of the Swedish Environmental Institute has put it.[45]

In May 2000 an Oxfam/Friends of the Earth (Europe) conference on 'The Impact of Biotechnology on Developing Countries' brought together industry scientists and representatives, as well as CGIAR scientists and NGO representatives. From this meeting it seemed evident that some scientists within the CGIAR oppose the corporate research agenda on GM technology, although they support those genetically engineered crops that they consider beneficial to the people of the South. Many also support a different system of patent protection that allows open access to genetic materials rather than corporate ownership.

> It will be a serious, and quite probably insurmountable, challenge for the IARCs to team up with the private sector while still being responsive to the world's farmers…. The consequences of being dependent on industry's products and agenda are far more serious in the Third World, because the lack of accountability means that industry will be even less concerned about producing products that really work and are safe. In addition, Third World farmers do not have the same kind of safety nets as their Northern counterparts, and a failed crop may mean starvation.[46]

The erosion of humanity's agricultural heritage

Involvement in any way in genetic engineering biotechnology could well be seen as contrary to the mandate of the CGIAR. Farmer varieties are critical for food security, and many were eliminated by the green revolution, yet:

> The pace of biotechnological breakthroughs is so fast that one could safely say that no genetic conservation system exists which could collect the traditional varieties as quickly as they will likely be eliminated by biotechnology.[47]

Although this comment was made in 1990, it still applies. The CGIAR might respond that its gene banks are safe deposits for these varieties. However, there are many questions about the viability of the collections. Stored seeds need to be planted and harvested at regular intervals to remain viable and the preparation and storage of germplasm has not always been according to the rules.[48] A warning was sounded as early as 1979: 'It is estimated that even in developed countries such as [the] USA and Australia from half to two thirds of accessions brought in over several decades have been lost.' [49]

The precious heritage of agricultural diversity needs to be protected in the field, not only in gene banks. Agricultural biodiversity depends on people to maintain it and ensure it continues adapting and evolving in response to new challenges from pests and environmental and climatic changes.

Modern breeding is increasingly based on 'one gene' strategies. The focus is on the identification and selection or transfer of individual genes conferring a desirable trait such as resistance to a pest or disease. The problem is that a one-gene defence system can quickly be overcome by the pathogen, thus rendering the resistance gene useless. Long-term stable resistance is conferred by whole groups of genes interacting with each other and being able to alter and adapt the plant's response. Such complexes have evolved through natural ecological dynamics, helped by farmer selection and traditional breeding. Co-evolution between crops, pests, diseases and environmental factors is continuous and vital for healthy and sustainable farming systems and crop health, including pest tolerance and resistance. This is a major reason why *in situ* conservation of varieties – continuing adaptive preservation of varieties in the field through frequent planting and harvesting – is the most effective way to maintain germplasm. Genetic uniformity – as monoculture hybrids show – leads to a uniform response. Once the pathogen has adapted to the defences of one plant, it has the key to all the plants in the field. Thus genetic uniformity or reliance on single genes leaves plants vulnerable and puts the crop and those who depend on it for food or livelihood at risk.

Genetic engineering takes the process of narrowing the genetic base of crops still further. It sidesteps traditional breeding practices that at least allowed gene complexes to survive and evolve. It is likely to continue and intensify the trend of working with a single gene for resistance and planting monocultures. It will also continue the process of eliminating farmer varieties. These can be lost very quickly through using modern hybrids with high levels of inputs even for a short time, because this changes the soil ecology and the interrelationships between plants, soil micro-organisms, pests, predators and nutrients. Even if the varieties are not lost, the soil ecology may be so much altered by chemical pesticides and fertilisers as to hinder the farmer variety from growing. Soils may take a long time to regenerate if the microflora and soil structure have been seriously damaged.

From 'miracle' rice to hybrid seeds: the International Rice Research Institute (IRRI)

> *We are being starved to death and we've starved to death for 20 years…. We are in this predicament because of the direction which IRRI research has taken over the last 20 years ... IRRI should not only be dismantled, it should be sued by the farmers' organisations ... I think IRRI stands indicted for complete and absolute negligence, at the very least….'*
>
> Alejandro Lochauco, lawyer, at the national conference of the Philippine peasants' organisation (BIGAS) in 1985, months after IRRI celebrated its 25th anniversary

Rice is the world's most consumed staple food grain, with half the world's people depending on it. It is harvested on about 146 million hectares, representing 10 per cent of global arable land. The yield is reported as 535 million tons per year and 91 per cent is produced by Asian farmers, especially in China and India (55 per cent).[50] Rice is primarily consumed where it is produced. In 1998 only 5.3 per cent (28.6 million tons) of the world's rice production was traded internationally.[51]

IRRI was established in 1960 by the Ford and Rockefeller foundations with the help and approval of the government of the Philippines.

> From its founding, IRRI was registered as a non-stock non-profit corporation under Philippine law. In 1979, President Ferdinand Marcos granted IRRI a number of diplomatic immunities and privileges through Presidential Decree 1620. Under PD1620, IRRI is immune from civil, administrative and penal proceedings in the Philippines.[52]

Rice is not just a daily source of calories – farming is intrinsically linked to Asian lifestyles and heritage. Present indigenous and local varieties are the product of centuries of breeding and selection by farmers to produce rice suitable to their environment and needs. IRRI was founded with a clear agenda to increase rice production and the mandate to preserve traditional seeds and varieties (germplasm). However, the Institute's leaders persuaded government officials that research on local rice varieties was no longer necessary and this halted such research for nearly three decades.

A conference in 1985 attended by 45 farmer organisations, progressive scientists from the University of the Philippines and development NGOs demanded the immediate dismantling of IRRI and the launch of a national programme on rice to respond to their needs, and to work within their capacities and limitations. They also demanded collaboration with progressive scientists for farmer-led research on rice. The fortieth anniversary of the Philippine-based IRRI, in April 2000, was marked by mass protests by farmers.

The breeding race: from high response to hybrid

In Sri Lanka as in the Philippines, the first IRRI representative urged the government to phase out its own rice research on the grounds that IRRI could supply all the new varieties needed. In 1966, IRRI released its first variety of high-response rice, IR-8, the cross-breed of a Taiwanese dwarf and an Indonesian variety. 'Despite several serious drawbacks – IR-8'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 IR-8 or similar semi-dwarfs.' By 1986, this figure had reached 55 per cent.[53]

> A few years ago, the famous 'miracle strain' of rice in the Philippines, IR-8, was hit by tungro disease. Rice growers switched to a further form, IR-20, whereupon this hybrid [actually line] soon proved fatally vulnerable to grassy stunt virus and brown hopper insects. So farmers moved on to IR-26, a super-hybrid that turned out to be exceptionally resistant to almost all Philippines diseases and insect pests. But it proved too fragile for the island's strong winds, whereupon plant breeders decided to try an original Taiwan strain that had shown unusual capacity to stand up to winds – only to find that it had been all but eliminated by Taiwan farmers as they planted virtually all their ricelands with IR-8.[54]

IR-26 thus gave way to IR-36, which by 1980 was increasingly susceptible to a new strain of brown planthopper and was by 1982 replaced by IR-56. Breeders are in a constant race to stay a step ahead and hardly any of the highly inbred HRVs (high-response varieties) last more than a few years before showing declining resistance to natural stress and giving lower yields.[55]

True breeding lines versus F1 hybrids

F1 hybrids are the first generation outcome of crossing two varieties. They are of particular interest to the seed business because they give a uniform performance, while their harvested and replanted seed (F2) will not. As a largely self-pollinating crop, rice is a poor candidate for producing F1-hybrids. IRRI's HRV rice varieties are often called 'hybrids', but are actually true breeding lines, created through one step of 'hybridisation', but then made stable through multiple backcrossing (repeated crossing between a hybrid and one of the parent strains over many generations).

Due to the difficulties of producing F1 rice hybrids on a large scale, private industry did not enter the seed business until tempted by the profits assured through intellectual property rights, mainly patents (see below) and the potential for F1 hybrids. The advent of a male sterile line, called a *maintainer line*, developed by Chinese scientists, opened the door to commercial F1 hybrid seeds, as such plants depend on the pollen of other plants, called *restorer lines*, to produce seeds.

IRRI, the FAO and the Asia Pacific Seed Association (APSA – a group including all the public and private seed companies) have entered into a collaboration entitled 'Development and Use of Hybrid Rice in Asia' –funded by the Asian Development Bank (ADB). Under the leadership of Sant S. Virmani, IRRI has been developing hybrid rice technology since 1979. Dr Virmani recently stated:

> In 2001, more than 700,000 hectares were planted to rice hybrids in irrigated areas in Vietnam (480,000 hectares), India (200,000 hectares), Bangladesh (15,000 hectares), the Philippines (5,000 hectares), Myanmar (10,000 hectares) and the USA (10,000 hectares).[56]

F1 hybrid seeds are difficult to produce and cost ten to fifteen times more than ordinary seeds. Crops are dependent on well-irrigated land and costly inputs. Even then, yield increases have been disappointing. Furthermore, the rice is said to have a poor flavour and is vulnerable to pests. As Dr Virmani states, 'this technology is not for farmers who are still struggling at the level of two or three tons' – which is exactly where the vast majority of rice farmers in Asia are placed.[57] This makes it hard to see how developing hybrid rice fits in with IRRI's mandate. IRRI thus acknowledges that its research is primarily to encourage commercial production. Asian governments have also concentrated their support for rice production on larger farms, implementing agricultural programmes to promote biotechnology and F1 hybrid rice. [58] Judging by previous history, the development of hybrids is likely to benefit the private sector rather than the small farmer, with yield increases remaining quite small and seed prices becoming very high. In fact, hybridisation has been called 'the scam of the century'. [59]

Rice patents and genetic engineering

A number of circumstances have now come together that make it worthwhile for biotechnology companies to enter the rice seed market. These include: the increasing availability of patent and seed protection; the technological advance in the development and production of F1 hybrid rice seeds on a large scale; and the availability of networks promoting microcredit and new technologies, which sometimes work together.

In February 2000 Monsanto enthusiastically announced that it and other seed giants were pouring money into hybrid rice research. The company explained, 'With the advent of adequate intellectual property protection in several countries, private sector investment in rice has dramatically increased in the seed industry.' [60] Intellectual property regimes enable companies to charge an additional 10–30 per cent over the cost of any seed, in the form of royalties and licence payments. Furthermore the sequencing of the rice genome by Monsanto as well as Syngenta shows their keen interest in establishing leadership in the now lucrative rice seed market.

According to the Philippine Farmer–Scientist Partnership for Development, MASIPAG, [61] IRRI has field-tested genetically engineered blight- and blast-resistant rice and are also working on Bt rice. Components of the resistant rice, from the gene itself down to the markers and promoter, are patented by Monsanto, Novartis and other Northern companies or institutions.

In January 2001 the first samples of the GM pro-Vitamin A rice, known as Golden Rice, arrived at IRRI (see pp. 135–40) to be welcomed by its Director-General, Ronald P. Cantrell:

> The arrival of these initial samples at IRRI is a very significant step and allows us to finally start on the required testing processes using local rice varieties. IRRI expects to play a major role in the ongoing 'Golden Rice' research effort and its eventual introduction to the world's millions of poor rice farmers and consumers. [62]

Companies including Syngenta Seeds AG, Syngenta Ltd (Novartis & Zeneca), Bayer AG, Monsanto Company Inc., Orynova BV, and Zeneca Mogen BV have patents on technologies and gene sequences involved in Golden Rice. Syngenta was later granted the rights to commercialise Golden Rice and it was agreed that no charge would be made for 'humanitarian use' in any developing nation. Syngenta has now become a major funder of IRRI.

Bt treasure trove

Plant Genetics Systems (PGS), later owned by Aventis, which in turn has become Bayer CropScience, also worked with IRRI. In 1996, hybridisation and insect tolerance accounted for over 90 per cent of the PGS research and development budget. The primary target was to genetically engineer crops with insecticidal toxins from the soil bacterium *Bacillus thuringiensis* (Bt toxins). The PGS collection of over 12,000 strains of *Bacillus thuringiensis* was mainly obtained from IRRI in Laguna, the Philippines, as part of a two-year project funded by the Rockefeller Foundation for the isolation, identification and characterisation of Bt strains able to kill rice pests. [63] Many of these were taken from IRRI in return simply for the training of some IRRI scientists in PGS's laboratories.

5.3 International Foundations

There are a number of extremely powerful international, mostly US-based foundations involved in agriculture and biodiversity projects in the South. They include the Ford, Rockefeller, MacArthur and Winrock foundations. Many of these large US foundations are built on corporate profits from major industries such as oil and automobiles from bygone days. Some of their funding assets will have been drawn from the exploitation of resources in the global South. In the 1950s the Rockefeller and Ford Foundations sent agricultural researchers to the Third World to work alongside national institute personnel (see p. 188). Both foundations were also founders and architects, with the World Bank, of the CGIAR system, established in 1971. Although these foundations support projects carried out by local communities in the Third World, the decision to grant the money and the rules about how it is to be used are made by a US foundation. Moreover, US foundations are obliged by statute to abide by US policy and promote US interests abroad. The cynical could therefore be forgiven for feeling that they are just another arm of US government, albeit indirect.

The Rockefeller Foundation[64]

The Rockefeller Foundation describes itself as a 'knowledge-based, global foundation with a commitment to enrich and sustain the lives and livelihoods of poor and excluded people throughout the world'.[65] Founded in 1913 and endowed by multi-millionaire John D. Rockefeller, it has since given more than $2 billion in grants worldwide. For 1999, the Foundation had a grant-making budget of $177 million dedicated to projects that 'promote the well-being of mankind throughout the world'. [66] Its assets are given as $3.5 billion.

The Foundation's general objectives are set out as the promotion of scientific advancement. Its association with the science of genes began during the 1930s, when Warren Weaver of the Rockefeller Foundation coined the term 'molecular biology' and poured money into research. It also began funding agricultural projects in the South during the 1930s and was perhaps the major proponent of the green revolution. Now it is one of the biggest funders of genetic engineering projects in the South, both directly and indirectly through the ISAAA (see below) and other NGOs. It has a large agricultural biotechnology programme, funding all aspects of genetic engineering research and work on patenting with Southern agricultural institutions.

The Foundation initiated an International Programme on Rice Biotechnology in 1983. Over the next 17 years, $105 million were spent on furthering the development of rice varieties and capacity building, culminating in 2000 with a series of final rice grants awarded in Asia. The funding emphasis has now begun to shift towards Africa.[67] These funds constitute a considerable portion of overall funding for agriculture research in many developing countries and, consequently, the Rockefeller Foundation exerts a significant influence over the direction of national R&D.

In 1998, when Professor Gordon Conway became president, the Rockefeller Foundation moved to take a middle position in the global GM debate. Conway distinguishes between the use of *tissue cultures*, to cross species that would only very rarely cross in nature; *marker-aided selection*, which helps to identify a gene in normal cross-breeding; and *genetic engineering,* when discussing biotechnology. [68] He situates biotechnology within the Foundation's support of integrated pest management (IPM) – an agricultural system that moves away from using chemical pesticides and encourages the use of natural predators – and he argues that certain genetic engineering applications, such as genetically engineered pro-vitamin A rice, can contribute to food security. Conway has publicly criticised Monsanto and other companies for fast-tracking GM products in the South and developing Terminator seeds, but at the same time he supports the participation of the private sector in the expansion of biotech R&D in the South. Conway believes that the needs of the poor and the interests of the biotech TNCs can be brought together. In this spirit he has urged corporations to abandon their pursuit of Terminator seeds and to allow exceptions in their intellectual property rights to make important crops freely available to subsistence farmers.

The first agreement of this kind concerns the Pro-Vitamin A rice developed by Swiss and German researchers with funds from the Rockefeller Foundation (see pp. 135–40). Syngenta acquired the rights to Golden Rice on condition that it make the rice freely available to a segment of farmers –those earning less than $10,000 from it each year – if the rice they produce is not exported. An IPR adviser at the CGIAR says that this kind of market segmentation is a 'practical problem' in areas 'where there are both subsistence and large-scale farmers'.[69] The Public Sector Intellectual Property Resource for Agriculture (PIPRA) was launched in July 2003 to facilitate further agreements for access to patented technologies for 'humanitarian use' for the benefit of both subsistence farmers and US agriculture.

The Rockefeller Foundation also funds non-GM research, looking at natural pest and weed management as exemplified by work at the Nairobi based International Centre of Insect Physiology and Ecology (ICIPE), where research is being carried out into termite, stemborer and tsetse fly control, and into controlling losses in maize cultivation from stemborers and *striga* weeds using napier grass and *desmodium* plants. [70]

5.4 International Organisations Promoting Biotechnology

International Service for the Acquisition of Agri-biotech Applications (ISAAA)

> *Biotechnology offers the unique opportunity to deliver a scale-neutral and appropriate technology to subsistence farmers by incorporating one of the most sophisticated technologies known to science in the technology best known and accepted by farmers, the seed.*
>
> ISAAA mission statement

The ISAAA was set up in 1991, based on the earlier International Biotechnology Collaboration Programme.[71] It collaborates with research institutions in the South, brokering agreements to develop biotechnology projects and secure funding through other research institutions and corporate research programmes. In 2001 the ISAAA was operating in twelve countries – Indonesia, Malaysia, the Philippines, Thailand and Vietnam in Asia; Kenya, Egypt and Zimbabwe in Africa; and Argentina, Brazil, Costa Rica and Mexico in Latin America.

The ISAAA is closely linked to the CGIAR network. It was set up and is still run by Dr Clive James, former Deputy Director-General of the CIMMYT.

- The first ISAAA centre, the *AmeriCenter*, opened in 1992 at Cornell University in the US, where the ISAAA's most recent Executive Director, Anatole Krattiger, another former CIMMYT employee, was stationed.
- The *AfriCenter* is based at the regional office of the CIP, Kenya.
- The *SEAsia Center* is based at IRRI in the Philippines.
- The *EuroCenter* is based at the John Innes Centre, in the UK
- The *AsiaCenter* is based at Technova Inc., in Japan.

Donors include the World Bank, Rockefeller Foundation, USAID, the UN Environment Programme, Aventis (AgrEvo), Novartis, Monsanto, Pioneer Hi-Bred International, Cargill Seeds International, Dow Agro-Sciences, the Biotechnology and Biological Science Research Centre (BBSRC) (UK), the Gatsby Charitable Foundation (UK) and the Hitachi Foundation (Japan). Both Monsanto and Novartis have been on the board of directors. Other directors include representatives from CGIAR and the World Bank.

Monsanto and the ISAAA

Monsanto donated genes for protection against potato viruses X and Y (PVX and PVY) to Mexican researchers for engineering into local varieties of potatoes grown for local consumption. The same genes were donated to the Kenyan Agricultural Research Institute (KARI) for sweet potatoes which can suffer from the same plant viruses. The ISAAA brokered both these deals while the Rockefeller Foundation provided funding. As part of the deal, Monsanto provided not only the genes but also training for Mexican researchers, one of whom studied field trial protocols and regulatory issues in the US.

Monsanto gained not only from familiarising Mexicans with the idea of transgenic crops, but also in managing to export industry-friendly TRIPs-style regulatory procedures to Mexico. In doing so, Monsanto managed to ease the entry of its own commercial varieties into the country.

According to the ISAAA, the deal 'helped Mexico establish regulatory procedures and a bio-safety review system…. The US companies were able to supply Mexican authorities with information on field problems, on potential risks that field testing might pose, and on how to deal with them.' [72]

The work at KARI was started by Dr Florence M. Wambugu, who trained at Monsanto and who was the head of the ISAAA's AfriCenter until October 2001. She is an outspoken supporter of genetic engineering technology, and is frequently quoted as an independent Southern scientist by Monsanto and the biotech industry as a whole. She said of her critics: 'They don't want Africa to embrace biotechnology because they know the technology has the potential to solve Kenya's famine problems.' [73]

Florence Wambugu has been engaged as a strongly pro-biotechnology speaker at international events sponsored by the biotech industry, such as the lunchtime lectures at the Biosafety Protocol negotiations during the Biosafety Convention held in Montreal in 2000.

With the engineering of one unpopular potato variety against the American strain of the virus, the KARI sweet potato project has done little to meet the needs of small farmers. Instead it helped to drive the implementation of legislation on intellectual property rights and biosafety in Kenya in exactly the same way as Monsanto's gift of potato genes achieved the introduction of a biotech-friendly regulatory regime in Mexico. [74]

Norman Borlaug and M. S. Swaminathan, two of the best-known scientists of the green revolution, are patrons.

As well as technology transfer, the ISAAA promotes 'capacity building' workshops and training for national policy makers and scientists. These encourage the development of national regimes of intellectual property based on the US model. Such a system of 'plant patenting' has been resisted by many Southern NGOs and scientists. ISAAA also provides fellowships and exchanges for Southern scientists to visit high-tech corporate research facilities.

ISAAA has brokered deals between Monsanto and research institutes in Mexico and Kenya (see Box, p. 127: 'Monsanto and the ISAAA'). Other ISAAA projects include the tomato spotted wilt virus project in Indonesia and the Papaya Biotechnology Network (aiming to eradicate the papaya ring spot virus or PRSV). Both diseases are prevalent and enhanced by monoculture cultivation practices that commonly go hand in hand with cash-crop planting for the export market. In this context it is unclear how these projects will be of value or affordable to small farmers; indeed, it seems that they might further the expansion of cash-crop farming at the expense of food security. One-gene defence strategies may amount to little more than a short-term techno-fix further compounding the agricultural problems of both South and North. In short,

> ISAAA is a valuable tool for the biotech industry. On the one hand, it supports a constant stream of public relations exercises to propagate hype about humanitarian motives behind biotechnology. On the other hand, it concentrates on generating the proper business climate for the biotech industry's market expansion in important developing countries. [75]

The Citizens' Network for Foreign Affairs (CNFA)

The CNFA describes itself as a 'non-profit, non-partisan organisation dedicated to stimulating international economic growth in developing and emerging world markets'.[76] The brainchild of former US secretary of state Henry Kissinger, it was founded in 1985 just as cracks were emerging in the former USSR. Its name, suggesting a civil society organisation, is misleading. An alliance of some 250 US organisations in agribusiness and banking, it counts Monsanto and Pioneer among its members. It is closely linked with the Citizens' Network Agribusiness Alliance (CNAA) and is an industry-led initiative set up to ensure that US agribusiness gains a stronghold in these emerging markets. CNFA president John H. Costello also has links with the World Bank, as part of its 'agribusiness and markets thematic group'.

It has been working in the food and agriculture sector of the new independent states of the former Soviet Union (Ukraine, Russia, Moldova and Belarus) and in southern Africa (Zimbabwe, Mozambique and Zambia). The CNFA is expanding its model of public–private partnerships into different economic sectors and disciplines, and into other developing areas of the globe. An important part of its work has been to create a hospitable political and legal climate for US business. In the Ukraine, the CNFA has been very active in promoting Monsanto's GM potatoes (see Chapter 7). Its representative in the Ukraine, environmental lawyer Wayne Williams, worked with the Ukraine Ministry of the Environment to prepare GMO legislation.[77]

Beyond this, the CNFA is involved in international lobbying:

> To protect the investments of American agribusinesses, CNFA also supports local agricultural institutions which challenge entrenched state systems that hinder the fledgling private sector. Internationally, CNFA's participation in the Gore–Chernomyrdin and Gore–Kuchma commissions helps ensure effective representation of US agribusiness in bilateral discussions.[78]

Corporate supporters and sponsors include: AgrEvo, American Home Products Corporation, ADM, Cargill Inc., Cyanamid International, Dekalb Genetics, DowAgroSciences, DuPont, Farmland Industries, Iowa Export–Import, Kraft, Monsanto, Novartis, Pioneer Hi-Bred International and Rhone–Poulenc.

The agribusiness partnerships program

> *This public–private partnership is a win–win initiative. It will help US agribusiness compete and succeed in Ukraine without shouldering all the risks on their own, while USAID benefits from leverage that will provide more agricultural assistance for every US taxpayer dollar invested in the program.* [79]
>
> John Costello, CNFA president, 1995

In 1993, the CNFA was awarded $44.5 million by USAID and $109 million by US agribusiness to implement a three-year Food Systems Restructuring Program in the former Soviet Union. The aim of this programme was 'to replace ageing and inefficient state-owned communist-style enterprises with privately owned and operated commercial joint ventures'. USAID subsequently gave a further $26.5 million, while an additional $32.4 million was contributed by Russian and Ukrainian partners. The Russian programme was mainly completed by 1996, with a further $100 million in private sector assets being leveraged in 2001 to strengthen food systems in Ukraine, Belarus and Moldova.

There are currently 19 partnerships in Ukraine and Moldova. They cover the full spectrum of food production: from agricultural inputs (seed, fertiliser, pesticides), to food and feed processing and marketing. US companies that have established joint ventures through CNFA's Agribusiness Partnerships Program include Monsanto, Global Agricultural Management Enterprises, Cargill (Seed and Fertiliser), Cyanamid, Progressive Genetics, Pure Sunshine, Developed Technology Resource Inc., Kyiv-Atlantic and Food Pro.

RAISE (rural agricultural input supply expansion)

RAISE is yet another CNFA programme – this time in Zimbabwe – to expand the market for transnational agricultural corporations. The following project description for 1999–2001, found on the CNFA website, illustrates the new interest taken by transnationals in small farmers:

> Smallholder farmers in Zimbabwe will not be able to make the transition from subsistence to commercial farming without modern agricultural inputs. International farm input supply companies such as Monsanto, American Cyanamid, Cargill, Novartis, and Pioneer are active in Zimbabwe. Many see the market potential in the small-scale farming sector, but the distribution network to get agricultural inputs from the supplier to smallholder farmers is inadequate. As a result, less than 10 per cent of farm inputs sold in Zimbabwe reach small-scale farmers though they outnumber large-scale farmers 200:1.
>
> In order to stimulate expansion of supply links to small-scale farmers, CNFA's RAISE program is working with both village-level retailers and agricultural input suppliers to build effective links between the two. RAISE will develop a commercially sustainable web of input wholesalers and retailers who can expand their markets and sell inputs to smallholder farmers. [80]

RAISE is now expanding to Malawi. In June 2002 CNFA received a Rockefeller Foundation grant of $2 million for rural development in southern Africa. The main aim is stated as:

> Development, in partnership with farm input supply companies, of a financially sustainable business management training program for Malawi designed specifically to enable village-level shopkeepers to qualify as farm input distributors and receive inventory credit from supply companies.… Creation of a guarantee fund to stimulate an increase in farm input supplier credit to village retailers and thereby improve and expand the flow of inputs to disadvantaged smallholder farmers in Malawi. [81]

In contrast, the organisation UBINIG (Policy Research for Development Alternatives) of Bangladesh believes that closing down shops that sell agricultural inputs is one of their major achievements.[82] It highlights the degree to which Africa is being targeted as a new frontier by the corporations and their networks. They may hope to meet with less resistance in Africa than in Asia, just because the green revolution failed to take root in Africa and people are less aware of the likely impacts than they are in Asia (see Chapter 8; see also World Bank, this chapter, pp. 104–6).

Other current programmes of the CNFA

The following programme descriptions are taken directly from the CNFA website:

Development Education – The CNFA engages public and private sector leaders throughout the United States in unique dialogue on the US stake in promoting economic growth and sustainable development in the world's emerging economies.

Citizens' Network Corporate Sponsor Program – The CNFA offers a special programme to US food and agribusiness executives and other interested parties to keep them abreast of new investment opportunities in emerging economies, particularly those of the former Soviet Union. Through the voluntary contributions of its sponsors, the CNFA can continue to foster the development of marketbased economic systems, democratic structures, and trade and investment opportunities in emerging markets around the globe.

Citizens' Network Agribusiness Alliance (CNAA) – More than 250 businesses, organisations and individuals participate in the CNAA, which harnesses the creativity and technical know-how of its members to redesign food and agriculture systems and build markets in developing and emerging economies.

Agribusiness Volunteer Program – This programme sends US agribusiness professionals and farmers on short-term overseas assignments to provide direct, hands-on assistance to their counterparts in emerging economies and developing nations.

5.5 Universities and Research Institutes

The universities are cheering us on, telling us to get closer to industry, encouraging us to consult with big business….We can't help but be influenced from time to time by our desire to see certain results happen in the lab…. All of these companies have a piece of me. I'm getting checks waved at me from Monsanto and American Cyanamid and Dow, and it's hard to balance the public interest with the private interest. It's a very difficult juggling act, and sometimes I don't know how to juggle it all.

John Benedict, former Texas AM University entomologist[83]

There are a number of reasons for the influence that biotechnology companies exercise over universities and research institutes. Biology used to be of little interest to industry; now it has become a major field for identifying profitable applications and technologies. At the same time the equipment and materials needed for research, especially in molecular biology, are very expensive, requiring high-grade chemicals and facilities. Governments eager to participate, such as the UK, Canada, Australia and the US, have contributed funds to promote partnerships between universities and industry. Such high costs put biotech research beyond the reach of many Southern governments, especially where they are cutting back expenditure due to structural adjustment programmes. Moreover, private research money is not currently going to Southern countries. In addition, the General Agreement on Trade in Services, one of the World Trade Organisation agreements, facilitates companies seeking to access and exploit university resources and set up whole departments within universities worldwide. The agrochemical industry offers lucrative research contracts and grants to training colleges, universities and research institutes to carry out particular research. However, it should not be forgotten that these companies benefit in return from public funding in the form of university infrastructure and other resources, such as intellectual capital and reputation. This diversion of public resources to private ends does not take into account the fact that most of these institutions were set up with public money for the common good, not to generate private profit. Industry is keen to promote its interests as being identical with the public interest, but there is considerable disquiet about the impact of corporate sponsorship on the independence of universities and the direction of research.

The increasing corporate colonisation of universities is another example of the appropriation of public assets that we are now experiencing in so many spheres, whether it is the water supply or traditional knowledge about medicinal plants. In the UK, organisations such as the Council for Academic Autonomy and the Council for Academic Freedom and Academic Standards are concerned to raise awareness of the issues.

Many educational and research establishments are now shaping academic courses towards winning corporate funding. Increasingly, scientific research is directed to areas with an industrial application, as companies seek to recover costs by bringing products to market quickly. Science and industry have come to be seen by politicians and university presidents as one and the same. Across most of the OECD countries, science policy is now the domain of government departments of industry.

Genetic engineering is an obvious example of a highly 'bankable' subject, offering the potential for big returns, so long as products can be developed. Indeed, the Biotechnology and Biological Science Research Council (BBSRC) reported that in the US, as closures and rationalisation plans dogged other university sectors, 'life sciences' was one of the fastest-growing university disciplines with 20 per cent growth between 1995 and 2000.[84] This makes it very difficult for scientists to remain independent – and objective. It also makes it hard for them to speak out, since they risk compromising their ability to work if they criticise the system or the priorities imposed by company funders. The threat to the future of independent science is clear, as already documented in 1990 by Henk Hobbelink:

> Monsanto has donated $23.5 million to Washington University for biotech research; Bayer is contributing to the Max Planck Institute in Cologne for the same purpose; and Hoechst built an entire $70 million biotech research laboratory for the Massachusetts General Hospital where research on crop genetics is also carried out.… Of the Hoechst grant for a biotech lab, one researcher has commented: 'Essentially, everyone in that lab is an indentured servant to Hoechst.' In most contracts, the TNC has the right to the first look at the results and can delay publication of them until patent possibilities are investigated.[85]

In other cases, companies and corporations contract out work to universities. To decode the rice genome, Monsanto relied on a new gene sequencing approach producing the data primarily in the laboratories of Dr Leroy Hood, at Washington University in Seattle under contract to the company.

Another approach is to sponsor high-level posts at universities. The Pioneer Hi-Bred Agronomy Professorship and the Pioneer Hi-Bred chairs in Agribusiness, Molecular Biology and Science and Technology Policy have all helped Pioneer Hi-Bred's cause at Iowa State University. As Steven Rose, Professor of Biology at the UK's Open University, has remarked,

> the old idea that universities were a place of independence has gone. Instead of which one's got secrecy, one's got patents, one's got shareholders.[86]

Corporate funding of US universities and patents

It is reported that in the US corporate funding of universities has multiplied sevenfold since 1970. It is still less than 8 per cent of the grand total but it is having a marked impact on the direction of research and on the manner in which it is undertaken.

Examples of partnerships include:

- Novartis, 1998: $25 million over five years to the University of California at Berkeley in return for being allowed to sift through plant and microbial biology research.
- Washington University in St Louis has had a funding deal with Monsanto for 20 years.
- Ribozyme Pharmaceuticals gave the University of Colorado a five-year, $500,000 unrestricted research grant in exchange for university research.

Nelson Kiang, professor emeritus at the Massachusetts Institute of Technology, has seen this kind of sponsorship increase massively over the years and believes that the university ethos of the free exchange of ideas is coming more and more into conflict with the corporate desire for business secrecy. The *Christian Science Monitor* reported in 2001:

> In fiscal 1999, more than 120 US research universities filed a total of 7,612 patent applications, according to the Association of University Technology Managers. Licenses to industry generated $641 million in gross income for the universities – and about $40 billion in economic activity overall.
>
> 'You used to have big corporations with labs that would do their own basic research,' Mr Kiang says. 'But … it's much more effective to turn the universities into R&D labs for them. By sprinkling money around … they don't have to compete for the best brains in the academic world, they simply buy them at low cost.' [87]

Unfortunately patent possibilities and financial interests in the outcome of research are reported to lead to delays in revealing breakthroughs. Corporate funding of university research is also reported to lead to less sharing of research information (a traditional academic freedom), the blocking of reports critical of new projects, and legal action against the reporters. Researchers may have a financial interest in the success of their research and be tempted to 'talk up' the results or suppress bad ones. It has also been found that many researchers receive research-related gifts. And these interests are not usually disclosed, leading to calls for more rules about disclosures of interests (see also Chapter 2, pp. 24–5).

Biotechnology and Biological Science Research Council (BBSRC) UK[88]

The BBSRC is Britain's leading funding agency for academic research and training in the biosciences. It was established in 1994 and according to its own mission statement its purpose is 'to sustain a broad base of interdisciplinary research and training to help industry, commerce and government create wealth'.[89] It replaced the Agriculture and Food Research Council (AFRC) and also took over some of the research funded under the Science and Engineering Research Council (SERC). The BBSRC is predominantly funded by taxpayers through the Science Budget. This is controlled by the Department of Trade and Industry via the Office of Science and Technology – at present under the auspices of Lord Sainsbury. In 1998, the Labour government's white paper on competitiveness launched a 'reach-out' fund to encourage universities to 'work more effectively with business'. The role of Higher Education Funding Councils, which provide the core money for universities, was redefined 'to ensure that higher education is responsive to industry'.

The chairman of the BBSRC from May 1998 to 2003 was Peter Doyle, the former chief executive of Zeneca. The BBSRC's strategy board has featured representatives of many companies over time, including Syngenta, GlaxoSmithKline and Genetix plc. in 2002. The Council has seven specialist committees, each overseeing the funding of different branches of biology. Zeneca is represented on all of them.[90]

In all, BBSRC funding has supported 98 UK research establishments and university departments. Representatives from some of these advise government, sit on regulatory committees and often get a public hearing.

- The BBSRC sponsors many of the key players in genetic engineering such as the Institute of Arable Crop Research, which is involved in assessing the GM farm scale trials, and the Institute of Food Research.
- In January 1999 the BBSRC set aside £15 million for 'a new initiative to help British researchers win the race to identify the function of key genes'.
- During 1999, further grants for £19 million and £11 million were announced.
- The BBSRC also funds the secondment of academics to corporations where they 'influence basic research relevant to company objectives'.
- The Council launched a Biotechnology Young Entrepreneurs Scheme aimed at encouraging more enterprise in the biosciences.
- The BBSRC has paid for researchers to work for Nestlé, Unilever, Glaxo Wellcome, SmithKlineBeecham, Aventis, Dupont, Rhone–Poulenc and Zeneca.

The John Innes Centre (JIC), UK

The BBSRC is the main public funding body of the John Innes Centre (JIC), UK, –contributing 47 per cent (or about £12.1 million) in 1999–2000, for example. It also funds the Sainsbury Laboratory, which is on the same site near Norwich in Norfolk, and which also receives about £2.4 million annually from the Gatsby Charitable Foundation (one of the Sainsbury trusts). Both the JIC and the Sainsbury Laboratory are companies limited by guarantee. The Centre is world renowned for its plant research and is often perceived as an independent public institution. The JIC presents itself as essentially publicly and charitably funded. According to its own annual report, in 1999–2000 it received funding from AstraZeneca, Aventis (AgrEvo), Monsanto, Unilever, Novartis Crop Protection, DuPont and the International Atomic Energy Authority.

The JIC also had a 10-year research agreement with AstraZeneca worth about £60 million (US$86.3 million) to establish the Zeneca Wheat Improvement Centre, later called simply the Syngenta Laboratory, in the Genome Centre on the Norfolk site. In September 2002 Syngenta announced that it would pull out of the project, citing the need for rationalisation following the merger of Novartis and AstraZeneca's agricultural research divisions. The JIC and the BBSRC announced their regret but insisted that this would not damage their commitment to wheat research. [91]

Although direct commercial sponsorship is less than 10 per cent of the overall annual funding, corporate influence extends to the whole culture within which the JIC operates.[92] In this way corporations gain an influence disproportionate to their contribution. Furthermore, the GM policy the JIC promotes appears to originate from a public institution, which gives it more respectability than if it came clearly from industry. It is worth noting that public funding for the Centre, via the BBSRC, was heftily increased by Lord Sainsbury as Parliamentary Under-Secretary of State for Science. A strong GM proponent, he also has a more pervasive influence on UK government policy. Until 1998, he was chairman of J. Sainsbury plc, the supermarket chain which contributes significant funds to the Labour Party.

The director of the JIC, Professor Chris Lamb, rounded off a reply (27 March 2000) to a letter of concern about the industrial linkages to the Centre's research with the following statement: 'I'm fighting the good fight for GM foods.' [93] The JIC has its own intellectual property company, Plant Biosciences Limited, and pursues a strong policy of patent protection.

On the educational front, the Centre organises pro-GM school projects and CD-Roms. It hosts the Teacher–Scientist Network, and with that body has commissioned a play about GM to tour UK secondary schools.

Golden Rice – and the Swiss Federal Institute of Technology

> *I share Greenpeace's disgust about the heavy PR campaign of some agbiotech companies using results from our experiments, which were exclusively done within public research institutions, and using exclusively public funding.*
>
> Ingo Potrykus, co-inventor of Golden Rice[94]

Vitamin A deficiency (VAD) affects 100–140 million children worldwide and causes 250,000–500,000 vitamin-A-deficient children to become blind every year, half of them dying within 12 months of losing their sight.[95] With its promise to combat VAD, Golden Rice was quickly identified and adopted as the long-awaited saviour for the beleaguered biotech industry. Overnight it became their symbol of genetic engineering's promise.

However, for others Golden Rice symbolises 'application-driven' science with a narrow focus and a top-down approach, characterised by a failure to consider the broader implications of the proposed development. Like the green revolution, it seeks to substitute technical solutions for necessary political and social change. Golden Rice demonstrates the use of patents and the barriers they create, the cost and complexity of dealing with multiple owners of intellectual property, and the use of public relations to persuade the public to accept genetic engineering 'solutions' in general. It also demonstrates the complexity of the relationship between 'independent' research and corporate interests, and provides an example of how publicly funded research can be co-opted by private interests.

In January 2000, an article in *Science* announced the creation of a genetically engineered rice containing pro-vitamin A (beta-carotene).[96] As the beta-carotene colours the grain orange, the rice was named Golden Rice. A pre-print of the article was sent to journalists around the world, ensuring global coverage of the news.

Exclusive rights for industry

In May 2000, AstraZeneca (now Syngenta) and Germany-based Greenovation[97] acquired exclusive rights to commercialise Golden Rice. The inventors say that this deal will give poor farmers in developing countries free access to the genetically engineered rice (see above), while allowing the life sciences company to sell it commercially in the developed world: what is called market segregation. Zeneca itself admits that the two-tier system will be hard to police. The Peasant Farmer Movement of the Philippines (Kilusang Magbubukid ng Pilipinas or KMP) made the following statement:

> Why should Zeneca have the right to patent for its own profit the results of publicly funded research? And why should anyone believe that this is for the poor when Zeneca has made it clear that their motive is to make money from the technology in the North? [98]

On 2 June 2000 BIOTHAI, KMP and MASIPAG (Farmer–Scientist Partnership for Development) issued a statement saying moves like Zeneca's 'are clouding the real issues of poverty and control over resources'.[99] And Gordon Conway, president of the Rockefeller Foundation, said in an interview:

> I agree … that the public relations uses of Golden Rice have gone too far. The industry's advertisements and the media in general seem to forget that it is a research product that needs considerable further development before it will be available to farmers and consumers.[100]

What lies behind the patent issue?

The research was presented publicly as the work of the independent Zurichbased Swiss Federal Institute of Technology, led by Dr Ingo Potrykus, in collaboration with Peter Beyer (University of Freiburg, Germany). Potrykus had spent the last 10 years working on this technology, transferring three genes from daffodils and bacteria into rice. His research was mostly funded by the Rockefeller Foundation and for shorter periods by (amongst others) the European Union, the Swiss Federal Office for Education and Science and (through the contribution to the carotinoid sub-project in the EU Biotech Programme) the company AstraZeneca.[101]

The *Scientist* reported in 2001:

> Potrykus maintained that 'from the beginning' he wanted to make golden rice available free of charge. Still, he couldn't turn his research into a product as a 'freedom-to-operate' study [carried out by ISAAA] revealed that 70 patents belonging to 32 holders covered technology used in the process. He convinced AstraZeneca to help tackle the problem, and together they agreed on a definition of humanitarian use that could circumvent patent obstacles: 'Everything which leads to a less-than-$10,000 annual income to farmers should be considered a humanitarian use,' Potrykus stated. The public/private compact paved the way for patent waivers.[102]

Co-inventor Peter Beyer stated in an interview with the *Hindu* newspaper on 7 November 2002:

> Farmers can produce and sell Golden Rice to the tune of $10,000 a year. But they can only sell it within the country and not export it.

There are at least three issues here. The first is the breeding of Golden Rice transgenes (engineered genes) into local rice varieties – the inventors' preferred option. 'Local varieties' might mean farmers' varieties but, in view of their widespread replacement by high-input varieties, could equally mean varieties like the widely grown IR64 rice developed by the Philippines IRRI. Harmut Meyer of GENET (European NGO Network on genetic Engineering) comments on the potential consequences:

> [E]ach rice variety that carries the Golden Rice transgenes seems to be barred from export by patents and contracts. If that is really true, the Golden Rice story gains a completely new dimension. The celebrated licence agreement in which biotech companies allow the use of patented technology for humanitarian use could have the potential to serve as means to control the rice economy of a whole country. One central demand to the inventors and owners of the Golden Rice is to disclose all licence agreements.

The second issue is potential patent infringement claims arising from unintentional cross-pollination of rice with the Golden Rice transgenes – as has been the case for Canadian farmer Percy Schmeiser, successfully sued by Monsanto for having their patented gene in his oilseed rape crop.

The third is whether the patent dilemma has been exaggerated or used as an excuse to hand all the rights to Syngenta. GRAIN noted that:

> of the 60 countries with Vitamin A deficiency – which Golden Rice is supposed to address – only 25 could possibly honour any of the patents involved. And in these countries, only 11 of the patents could constrain the project locally. Seven of those are held by four transnational corporations (Syngenta, Aventis, Monsanto and DuPont), two of which have expressed their interest to make the technology freely available to the poor. The other patents are held by public institutions. Furthermore, ISAAA's study looked at patent *applications* filed through the World Intellectual Property Office [sic], without confirming whether the patents were actually granted or not in the different countries.[103]

On the subject of patents Potrykus had strong words: 'So many fields of research are blocked by corporate patents. I had to ignore them or I couldn't move at all.' Scientists should simply break the law, he said. 'What company wants the negative publicity of putting me in jail for fighting poverty?' [104] On a similar note he observed in 2001 that 'industry cannot be expected to be bothered about problems of people and well-being of the poor as its interests are different'.[105]

However, Ingo Potrykus used to work at the Novartis-owned research institute, FMI, and he still has very close connections to this company. According to the Blueridge Institute,

database research revealed that Ingo Potrykus is named as 'inventor' and thus has interest in 30 plant-related patents, most of them belonging to Novartis [now Syngenta]. The latest Novartis patent with Potrykus as inventor was issued in February 1999 (No. US 5976880). Furthermore Potrykus admits himself that they filed a patent application for the transgenic rice ('before others do it').[106]

Access to vitamin A and other micronutrients

The biotech industry seems to suggest that Golden Rice is the only way to save children from VAD and blindness. So what happened to the natural sources of vitamin A, foods of animal origin such as eggs, dairy products, liver, meat or salt-water fish? The human body also produces vitamin A from pro-vitamin A (beta-carotene), which can be found in many plants, especially in carrots, yellow cassava, yellow sweet potato, mango and apricots (also in dried form), leafy greens such as spinach, coriander, curry and radish leaves, and, most of all, red palm oil.

The problem is not a lack of foods containing vitamin A and beta-carotene, but a lack of access to these foods. It is 'hidden hunger', including the loss of knowledge about the relation between diet and health, and the consequences of eating only rice. Furthermore, vitamin A and beta-carotene are fat-soluble nutrients and can only be properly absorbed in the presence of oil and other components. Children who suffer from diarrhoea due to dirty water and poor hygiene conditions will not be able to take up or retain nutrients like vitamin A from their food.

Consequently, the most effective international programmes targeting Vitamin A deficiency take into account cultural and economic considerations, with socially based strategies such as dietary diversification, schooling for girls and improved sanitation. In the assessment of the World Health Organisation,

> These strategies will include promoting breast feeding, dietary diversification to increase intake of vitamin A-rich foods, agricultural reform and food fortification. Public health measures to deliver vitamin A supplements, via immunisation programmes, and infection control will also contribute in appropriate situations; for example, the relative importance of each intervention, which will be country-specific. The delivery of vitamin A supplements is intended as a temporary solution to VAD until other more natural methods of raising vitamin A status have been found.[107]

Through existing programmes of food fortification – and without GM crops – VAD figures are already on the decline.

Food-based projects are in progress across Africa and South-east Asia. In Bangladesh, for example, families were helped by the FAO and others to grow vitamin-rich vegetables and fruits in small home gardens or vines up the sides of their houses, and to plant beans, pumpkins and bottle gourds in the vines – all of these have leaves which are commonly eaten. Health conditions improved and it was shown that small plots of land are enough to provide sufficient vitamin A. Scientific evaluation also showed that the uptake of pro-vitamin A (beta-carotene) increased with the number of varieties of vegetable and fruit eaten by a person, independently of the quantity eaten.[108] The highest levels of pro-vitamin A are found in natural food items such as the livers of animals, carrots, red palm oil, and certain green vegetables and fruits. Most palm oil has the red colour removed from it for marketing purposes, but this also removes the pro-vitamin A. Palm oil is used throughout Asia and Africa. Leaving palm oil with its original red colour and persuading people to cook with it might be a far more useful action than trying to persuade them to accept Golden Rice.

Given all the above, the glow of Golden Rice fades rapidly, not least because Golden Rice is a single-nutrient, single-plant approach. But there are other reasons for the gold to tarnish.

What has Golden Rice to offer?

Golden Rice does not exist yet in any usable form. First, pro-vitamin A is in the 'wrong' type of rice and still needs to be crossbred into varieties grown or consumed in the VAD-affected countries – this is probably the smallest of the hurdles. Second, no safety tests have yet been performed, either for human and animal consumption, or for impacts on the environment and biodiversity. Such crucial tests will take at least four years once the right variety has been developed. Third, no tests have been conducted to find out whether the beta-carotene present in Golden Rice can be absorbed when eaten and converted into Vitamin A. There is still a lack of understanding of the factors influencing this conversion and recent scientific data suggest that the conversion ratio is not 6:1, as previously thought, but rather 12:1 or even 21:1. This means that 6–21 micrograms of beta-carotene are needed to produce 1 microgram of vitamin A.

Another serious problem was first pointed out by Vandana Shiva:[109] could Golden Rice, in its current or its planned form, provide the amount of beta-carotene needed to achieve the recommended daily allowance of 400 (children aged 1–3) to 1,000 (males of 11 years and upwards) micrograms of vitamin A? [110] Whilst the current Golden Rice produces less than 1.6 micrograms of beta-carotene per gram of rice, the inventors of the pro-vitamin A rice stated that their ultimate goal was to achieve a rice that produces 2 micrograms per gram.[111] One hundred grams of rice would thus contain enough

beta-carotene to produce 9.5 micrograms of vitamin A or 33.3 micrograms at best, using the old conversion ratio of 6:1 (see above). A small child would thus have to eat 1.2 to 4.2 kg of uncooked rice per day, which swells to 3.6–12.6 kg when cooked, which no child aged between 1 and 3 years could possibly do.

In comparison, one carrot, whether eaten cooked or raw, will cover the whole daily requirement, and 100–200 grams of spinach, dandelion, kale, coriander leaf or amaranth will suffice, especially when a few drops of red palm oil are added.

Golden Rice thus stands accused of being either a fraud or an intentional diversion from relatively low-cost but effective initiatives that can help people to achieve a better diet almost immediately. Furthermore, the experience of Southern farmers is that intensive rice production with the use of high chemical inputs ended their integrated farming systems that included other food sources such as fish, snails, water fowl and green leafy vegetables to provide a wide range of essential nutrients, including vitamin A.

Meanwhile, new breeds of vitamin A-rich grains have been announced, namely millet (Golden Millet – ICRISAT)[112] and rice (Dream Rice – IRRI),[113] neither of which has been genetically engineered. Even so, as with Golden Rice, those grains cannot answer the problem of hidden hunger and malnutrition, which need a far more integrated solution.

5.6 Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Australia has shown itself to be a keen proponent of biotechnology. It was a member of the US-led Miami Group that sought to prevent the development of a meaningful Biosafety Protocol, and in 2003 it supported the US challenge to the EU at the WTO over GMOs. Australia's climate, the nature of its soils and the adoption of colonial agricultural practices unsuitable to its conditions have helped to cause numerous problems. It was one of the first countries where glyphosate resistance was reported in ryegrass and it has been involved in biopiracy cases, for instance appropriation of chickpea germplasm (see p. 113). As an important producer of agricultural commodities, Australia has committed itself to the search for technical solutions to its problems.

CSIRO is Australia's publicly funded national research organisation, often referred to as a government agency. It was founded in 1916 as the Advisory Council of Science and Industry by the Australian government as a step towards creating a national laboratory, so giving national standing to scientific research. After several name changes it became CSIRO in 1949 and

> gradually expanded its activities so that its research was related to almost every field of primary, secondary and tertiary industry. Many other areas affecting the community at large were also covered – such as the environment, human nutrition, conservation, urban and rural planning, water supplies. In 1971 CSIRO moved its headquarters from Melbourne to Canberra as part of a government initiative to bring the heads of its agencies closer to the daily workings of the Ministers they served.[114]

According to ecologist Richard Hindmarsh, Australia's plant breeding research has a 15 per cent involvement from the seed companies, which concentrate on particular crops for which hybrid seed can viably be developed.

> The other 85 per cent is done by CSIRO, state departments of agriculture and a number of university departments. CSIRO's R&D agenda embraces the release and widespread usage of genetically engineered plants, animals and other organisms.[115]

CSIRO is Australia's major cotton breeder, while the cotton seed market is monopolised by CSD (Cotton Seed Distributors) and its wholly owned subsidiary Cotton Seed International. Over 95 per cent of CSD's seeds are supplied by CSIRO in return for royalties.

> Both CSD and CSIRO access élite lines of seed from two US companies – Delta and Pine Land

> Co. and Cokers Pedigree Seed – for cross-breeding purposes.… What all these developments highlight is that, similar to the US trend, a convergence is occurring in Australia between the private and public plant breeding and seeds sectors under the impact of PBR [plant breeders' rights] and genetic engineering R&D. There is also a noticeable trend towards concentration of the private seeds sector. With regard to genetic engineering, already on the market is CSIRO-developed transgenic cotton – where the natural biopesticide gene inserted, that confers resistance to caterpillars, is licensed to CSIRO by Monsanto.[116]

CSIRO is actively developing genetic use restriction technology (GURT) applications for its patented gene switch ('pPLEX') technology. To this purpose it entered into a joint venture in 1999 with RhoBio (a Rhone–Poulenc and Biogemma venture specialising in the plant biotechnology of field crops), who will develop this technology for major crops, especially the cereal crops corn, wheat, rice and barley (see Chapter 8).[117]

Concerning biotechnology in the field crops sector, CSIRO states on its website that it has

> entered strategic alliances with R&D providers and funders, and industry. The aim is to help position the Australian industry with its own valuable intellectual property, enabling it to negotiate positions which give the freedom to operate in its own right or on appropriate terms in joint ventures with the multinationals.[118]

CSIRO finds a market for its own intellectual property (germplasm) and particular technologies, or accesses those of others, through alliances. Allies have included agbiotech corporations such as AgrEvo (Aventis) or Rhone–Poulenc Agro; national bodies such as the Australian National Insect Collection, the Australian National University; and Australian companies such as BioDiscovery and several grain companies.

A key alliance for insect bioprospecting, for example, was formed between CSIRO and BioDiscovery in 1997, with CSIRO creating a library of extracts obtained from insects collected across Australia and BioDiscovery screening the library for pharmaceutical or crop protection leads. In November 1998 Rhone–Poulenc Agro joined with an AU$1.5 million three-year agreement in order to find 'new natural products which are active in crop protection'.[119]

Notes

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