Genetic Engineering, Globalisation and Food Security

By Devinder Sharma*

It certainly is a brave new world in the offing. A stream of impressive new technologies for developing country farmers and consumers are promised for the next decade. The new technologies are all aimed at providing farmers with improved options that would help boost their incomes and livelihoods. And at the same time, these new technologies have all the ingredients to provide a future shock.

The new technologies -- and that essentially includes the controversial genetic modification of plants – have evolved from the stage of concept development to application. The evolution will continue with more extensive product development, which will lead to new agricultural applications and dramatic food industry expansion. Although the nature of the impact is still very unclear, and has the potential for both positive and more worrisome: an equally damming negative outcome.

Since genetic engineering is likely to emerge as one of the biggest commercial enterprises in the next century, vested financial interests are pushing technologies, which have not been adequately tested for human health and damage to the environment. In the past, for example, biotechnology's promoters have promised that fertilisers will become unnecessary as crops are engineered to fix their own nitrogen, and that pesticides will become obsolete as crops are engineered to resist insects and other pests. While the first promise failed to materialise, we now have herbicide-tolerant plants which, in fact, result in more usage of herbicides, Bt corn and cotton plants, which are increasingly becoming ineffective against major pests. And still worse, these GM products are being pushed in the name of 'feeding the world'.

These unrealistic claims have spurred general caution about new biotech products. Further, the political support for the new technologies too raises doubts about the effectiveness of the technologies. There is certainly a huge gap between reality and perception that needs to be filled. These products are being pushed to the South since the companies are keen on garnering more profits.

With a major shift from public to industrial funding, and with current intellectual property protection strategies narrowing, the nature of private research relating to biotechnology/genetic engineering is without much regard for its impact on food security. Moreover, in a hurry to market agricultural biotechnology, farmers are not only the last to be considered but are never consulted. Biotechnology is a science, which has gone beyond the control of the society or the farming community. Half a dozen executives of a biotechnology company, sitting comfortably in the air-conditioned Board rooms, take decisions that affect millions of farmers.

The underlying objective is very clear: to push the GM products onto developing countries. Most farmers in Asia-Pacific, Africa and Latin America are poor and cannot afford risk, particularly since no effective crop insurance mechanisms are yet in place in several countries of the region. Therefore, a careful cost-benefit analysis and social audit should be done before they are asked to switch over to new material resulting from recombinant DNA experiments. Allowing these biotechnology

companies a free run in developing countries in search of a desperate need for foreign investment is only going to push the farm sector into the throes of an unforeseen crisis.

Ever since the United States Food and Drug Administration (FDA) approved the commercial sale of gene-spliced 'Flavr Savr' tomatoes produced by the multinational Calgene Inc. in May 1994, agricultural biotechnology has raced ahead at a lightning speed. In fact, 60 food crops have already been genetically engineered -- a set of techniques for moving genes from one organism to another -- to make them 'market friendly', at least 20 of which are under commercial cultivation in North America.

The birth of Dolly the sheep, followed closely by her cousin Polly, only signaled the beginning. The transfer of genetic information from one organism to another, even across species boundaries, represents the most powerful tool for the improvement of plants and animals. The National Academy of Sciences in the United States reports that approvals have been given for an additional 6,700 field trials of genetically modified plants (2), whereas research is already progressing on 100-200 field tests of genetically engineered micro-organisms, and two field tests of genetically engineered fish. A number of crops are now being engineered to produce pharmaceuticals, polymers, and industrial enzymes, and to alter, oil, starch and protein contents.

The progress in biotechnology is essentially being targetted at the agriculture and food industry. The focus, for instance, is on commercial opportunities for tomatoes that stay firm and fresh (having a shelf-life of somewhere between 40 to 90 days), improving the strength of cotton fibres, and on products like genetically-engineered bananas, potatoes and tomatoes that may provide edible vaccines as replacements for injected ones, and so on.

As its use becomes more widespread and sophisticated, there is an increased public concern over the safety of genetically modified plants, within the food chain and within human foodstuffs. And as the British Medical Association, representing 115,000 doctors, said in its report (of May 1999), "At this stage in the development and application of genetic modification it is not possible to provide any guarantees against, or insurance for mistakes. When we seek to optimise the benefits over risks, it is prudent to err on the side of caution and above all to learn from our accumulating experience." The US National Academy of Sciences too says in its report confirming what critics have been saying about genetically modified crops: they have the potential to produce unexpected allergens and toxicants in food, and the potential to create far-reaching environmental effects, the creation of super weeds, and possibly adverse effects on soil organisms.

Agricultural biotechnology is essentially being developed for the western markets. No where in the biotechnology laboratories in the developed world is the focus on meeting the growing food needs of the developing countries. There is a huge gap between reality and perception that needs to be filled. Biotechnology industry is developing novel products, which have wider applications in the North. These products are being pushed to the South since the companies are keen on garnering more profits. For instance, the controversial recombinant bovine growth hormone (rBGH) was essentially developed for the American and European dairy farmers. It

was only after the European Union imposed a ban that the multinational industry, which developed the product, started looking for markets elsewhere.

With animals being treated as factories, the resulting health hazards and the ethical and religious considerations are being pushed to the background. The hormonal drug rBGH is being pushed onto developing countries, including India, Brazil and Argentina, without adequate scientific tests. First of all, it has to be understood that the drug was essentially an outcome of research on the exotic cattle breeds, which are quite different from the hardy and comparatively low-yielding cattle breeds of the developing countries. And more importantly, even if developing countries were to accept rBGH there is no assurance of a simultaneous increase in the intake of milk for the simple reason that people who are hungry and malnourished do not have the means to buy it. And in any case, the drug is being marketed at a time when the United States, European Union, Australia and New Zealand are waiting to deluge the South with highly subsidised milk and milk products once the trade barriers are lifted.

Take the case of cassava. It serves as a staple food for at least 300 million Africans. And yet, no biotechnology company made any effort to improve the crop yield and production. It was only after cassava was found to be a feed substitute for the growing pig industry in the US that four food and biotechnology companies have begun researching on cassava, amply indicating how animals take precedence over humans when it comes to economics.

Politics of Biotechnology: With the US Environment Protection Agency (EPA) approving yet another genetically-altered pest-resistant corn for commercialisation, the world is getting closer to an era of designer crops. Although some 20 food crops with alien genes are under commercial cultivation in North America, vested financial interests are pushing such technologies which have not been adequately tested for environmental risks.

Acting as a front for the multinational companies to force open the developing country markets for transgenic plants, US Department of Agriculture (USDA) has embarked upon a massive international programme to provide credibility to the American biotechnology industry untested claims. Under the garb of accelerating efforts in mobilising the tools of biotechnology and genetic engineering for improving crop productivity, profitability, stability and sustainability of the major cropping systems in the Asia-Pacific region, the USDA is promoting biosafety regulations that paves the way for smooth entry of transgenic plants, irrespective of the requirement and need of the people.

USDA's objective is very clear: to push the biotechnology products onto developing countries. In the bargain it refuses to accept responsibility for any environmental mishap that might happen. Since the USDA only accords approval for the transgenic product, it does not certify whether the transgenic is better than the existing plant variety or not. Nor does it specify as to why should a farmer undertake a biological risk by cultivating a plant variety, which falls in the category of a "genetically engineered organism" (GMO). The most crucial decision whether the transgenic plant should be used or not is left to the farmer.

In the Asia-Pacific region, while countries like Thailand and Korea are still holding on the genetically modified foods and crops, China and India have embarked upon a massive research programme in GM crops. China already has been commercially cultivating Bt cotton since 1996 but has so far refused to release for commercial cultivation some 46 transgenic food crops for reasons of fears to human safety. India has only recently, on March 26, 2002, approved the commercial release of Bt cotton. Reiterating that the management of safety standards to the social, cultural and agronomic practices should be first ascertained, USDA appears more keen to ensure that developing countries do not 'reinvent the wheel' as these transgenic products had already undergone a lot of testing in the west.

Monsanto had marketed the first genetically engineered tomato produced by Calgene in 1994, called "Flavr Savr", containing a gene that delayed ripening, allowing for fresher tomatoes at supermarkets. Pitted against strong consumer resistance and faced with stiff protests from green activists, "Flavr Saver" failed to excite the food industry and the consumers. Aptly described as 'an economic disaster' by the *Wall Street Journal*, "Flavr Savr" turned out to be an embarrassment for the multinational biotechnology seed company. It was subsequently withdrawn from the market in 1996. Let us not forget that "Flavr Savr" too was allowed to be commercialised after the USDA had issued a "no objection" certificate.

In 1996, cotton bollworms were found to have infested thousands of acres planted with the new Bt-induced transgenic cotton in Georgia and Texas in North America. Farmers' paid US $ 32 per acre as license fee to grow the crop primarily for protection against bollworm and had to suffer huge losses instead. The cotton failure triggered a slump in the stock market with the shares of Delta and Pine Land, which distributed the crop for Monsanto, briefly suspended on the New York Stock Exchange. Incidentally, the transgenic cotton that failed was approved by the USDA as well as the US EPA.

What the USDA, as well as the multinational seed companies, do not reveal, is that the EPA, for instance, had only accorded 'conditional registration' to corn and cotton varieties genetically engineered to express Bt toxins from bacteria. Several of the transgenic cottons in the US are restricted in usage due to fears of accidental release of the toxin gene into the environment. And yet, these genetically altered cotton and corn are being found to be completely safe for the developing countries. USDA has also been insisting that the transgenic plants do not pose any appreciable environmental risk worth mentioning.

At the same time, USDA accepts that it has so far not conducted any biological risk assessment. Nor does it have any plans to do so. While it lays down well-defined procedures for the introduction of transgenic material, it is not at all willing to be held responsible for any environmental and biological mishap. The dangerous effects of the biological fallout may be delayed, waiting for biological or environmental signals to create a cascade of responses otherwise impossible (1). In the case of medicine, for instance, the use of genetic technology has been regulated by the Recombinant DNA Advisory Committee (RAC) for 25 years. Before implementation of any medical application using genetic engineering, researchers must evaluate potential harm as well as benefit. Each experiment must be reviewed, and unexpected harmful results must be reported.

In the past, there have been serious repercussions when investigators neglected timely reporting of many experimental failures. Though the RAC is an imperfect restraint, but it is the best we have. For agriculture, which functions at larger scales of life, there is no equivalent of the RAC.

In Spain, those who produce or plant GMOs are being obliged to contribute to a US $ 100 million insurance fund to cover environmental accidents. In other developed countries, disaster plans are being drawn up, complete with sterilisation of large tracts of land in the event something gets out of hand. Most farmers in the Asia-Pacific region are poor and cannot afford risk, particularly since no effective crop insurance mechanisms are yet in place in several countries of the region. Therefore, a careful cost-benefit analysis should be done before they are asked to switch over to new material resulting from recombinant DNA experiments.

The growing fears over the release of genetic material into the wild are not unfounded. There exists numerous cases when alien genes introduced into a crop have escaped into the wild. In fact, the chances for such escapes to be frequent in the developing countries are much more for the simple reason that these countries are the repository of plant biodiversity. In any case, transgenics will greatly increases the opportunity to disrupt habitats and food security of humans directly and indirectly through our food web. Any deliberate or accidental genetic release, and developing countries will be open to biological pollution thereby sowing the seeds of an impending disaster.

The political battle for genetic foods: The stakes are high. For an industry which spent an estimated US $ 8 billion on biotechnological research in 1996 alone, the desperation for immediate economic returns is understandable. At the same time, the growing concerns over the grave risks these genetic foods pose to human health, ecology and the environment have forced many a government's to re-think on the need to introduce such designer crops.

For the first time, the European Commission's scientific advisers have recommended that a genetically engineered potato be withheld from the market because they cannot guarantee its safety. And worried at the growing acts of vandalism against the genetically engineered crops in Britain, where 300 incidents of uprooting and burning of genetically modified crops have shaken up the biotechnology industry in the recent past, bowing to public pressure the government had thought of imposing a three-year moratorium on transgenic crops grown for commercial use. But under relentless pressure from the industry, the British government is unable to refuse permission for new field trials.

As if this is not enough evidence, the British daily *The Independent on Sunday* had published an exclusive report showing how the United States had threatened to call-off a potential free-trade agreement with New Zealand over its plans to label and test genetically-engineered food. Publishing New Zealand Cabinet's documents, made available because New Zealand has a Freedom of Information Act, the newspaper report reveals how the US, the world's biggest producer of genetically-modified food, has been "bullying" the governments into protecting the economic interests of the seed multinational Monsanto. New Zealand earned US' ire over its decision to

introduce a comprehensive labelling system for food, including safety testing of genetically modified foods on a case-by-case basis.

The Cabinet note, dated Feb 19, 1998, states “The United States, and Canada to a lesser extent, are concerned in principle about the kind of approach by Anzfa (part of the Australian New Zealand Food Standards Council), and the demonstration of the fact this may have on others, including the European Union. The US has told us that such an approach could impact negatively on bilateral trade relationship and potentially end a New Zealand-US free trade agreement.” Angered by this revelation, several British MPs have been quoted as saying that the documents gave them the first clear evidence of the lengths to which the US will go to defend the American biotechnology industry. They believe that Tony Blair too has privately come under similar pressure from President George Bush and the US government.

Influencing judiciary

In India, a visiting American delegation of 10 judges and scientists met the Chief Justice of India, Mr. Justice A.S. Anand to impress upon him -- to the judicial fraternity, the benefits of biotechnology. It quoted Dr. Franklin M. Zweig, president of Einstein Institute for Science, Health and the Courts in the United States, who was a speaker in favour of genetic engineering at the 88th session of the Indian Science Congress in New Delhi in January 2001. Asked pointedly, Dr. Zweig denied that the two-hour meeting was to "influence" the judiciary, but said it was to "educate" the judge(s) about the basic principles of public information for use of courts and court systems.

The delegation, the report said, invited the Chief Justice to the US and offered to hold for the judges of the Supreme Court and the High Court "workshops" in America for educating them about transgenics, and safety protocols in biotechnology research. The delegation, which also comprised some Indian-born US scientists, explained its intention to work out agreements between nations to set "ethical guidelines" on genetic engineering. Similar attempts had been made by the working groups of the Institute in the Philippines, South Africa, Israel, Italy, the UK, Netherlands, and Canada.

Source: *The Hindu*, Jan 5, 2001

The cutting-edge technology, as it is fondly called by scientists, has often been advertised and promoted as a way of providing consumers with a greater choice of food, as well as a possible way to solve global problems of hunger and food shortages. Unfortunately, what is being conveniently overlooked is the fact, that hunger and malnutrition exists not because of lack of production but for lack of access. Biotechnology cannot make food cheaper at any cost. In fact, all indicators point towards still higher prices for food in the coming years.

Replacing the damming ‘circle of poison’ caused by the excessive use and abuse of chemical pesticides with ‘benevolent’ genetically engineered crops, and more importantly cotton, too is a misplaced emphasis. It is true that cotton alone consumes about 55 per cent of the pesticides used in India and elsewhere. It is also a fact that cotton pests, especially the American bollworm, has become resistant to even the fourth generation synthetic *pyrethroids.* But finding a solution in Bt-resistant cotton can lead to even more disastrous consequences. Already, several pests have developed

immunity against the Bt gene. And if the cotton bollworm too develops resistance against the Bt-cotton, it will force a still large number of farmers to commit suicide.

The resulting biological treadmill is certainly more dangerous than the chemical treadmill. The answer, therefore, does not lie in genetically altered crops. What has to be clearly understood is that the shifting reliance on transgenic crops – containing genes from other crop species, animal and human beings – is the harbinger of a Grave New World which surely has gone beyond the control of the human society. Half a dozen executives sitting in a board room take profit-oriented decisions that have serious implications for the people. The collective wisdom of these senior executives of private companies certainly needs to be questioned.

The Future Shock: Biotechnology industry claims to provide the answer to the growing food needs, improve the health of millions and provide a low-cost solution to most of the vexed problems relating to energy use. What it does not explain is that how the 'cutting edge' technologies can create major social dislocations, threatening the social fabric of the developing countries and spinning in return disastrous consequences for the food and livelihood security of millions of resource-poor farmers in the South.

The US Office for Technology Assessment had calculated that with the help of biotechnology, the total production of corn, soyabean and wheat in America has increased by 21 per cent, 68 per cent and 35 per cent by the year 2000, respectively. This certainly has resulted in an increased over-production of these crops and consequently, greater pressure to dump the surpluses on Third World markets. The worst would be the genetic impoverishment that is expected with the increased use of biotechnology. Unilever, for instance, already produces through biotechnology one million completely identical oil palms a year. Estimates are that the company will be able to meet the world' s entire demand of vegetable oils in the near future. The damage it will do to the fragile economy of the countries that bank upon vegetable oil exports can well be ascertained.

Already, exports of vanilla beans worth of US $ 100 million are in jeopardy in view of the reported success of an American company to produce vanilla flavours from plant cell culture in the laboratory. A California-based company, Escagenetics Corporation, claims to have developed a cost-effective process enabling production of bio-vanilla at a fragment of the original cost. This development alone threatens important export earning sources of a number of developing countries, specially Madagascar, the Comoroon and Indonesia and may affect nearly 1,00,000 small farmers engaged in vanilla cultivation. Some 70,000 vanilla farmers in Madagascar lost their livelihood when a Texas firm started manufacturing natural vanilla in the laboratory.

AgriDyne Technologies, a Utah-based company, had received in 1992 a $ 1.2 million grant from the USDA to develop a genetically engineered pyrethrum to enable the US to become self-sufficient in this pesticides. The company had announced to spend $ 3 million on the project to develop a key active intermediate product normally produced in the flower, which will then be converted to produce an almost unlimited quantity of pyrethrum. And in the bargain hit the livelihood of some 2,00,000 farmers in Kenya, Tanzania, Rwanda and Equador. Similarly, a number of technological developments

are under way that will adversely affect coffee growers as well as silk producing developing countries.

The introduction of high-fructose corn sweetener produced in the US through the use of immobilised enzyme technology has already replaced more than 2 million tonnes of imports of raw sugar. FAO estimates that global corn syrup usage has crossed the equivalent of six million tonnes of raw sugar, enough to displace some 10 million tonnes of sugar. Sugar substitutes will adversely affect some 50 million farmers, most of them in developing countries, in the next five years. These countries will also gradually lose one of their most important source of export earnings.

The list of such product substitutes is endless.

For the developing countries, the biotechnology industry's promise of higher investments is likely to come with a heavy price. For the countries in the South, biotechnology opens up a new frontier of crop displacement and a massive loss of farm livelihoods. Unless biotechnology is harnessed in a way that its focus shifts from a profit-generating industry to strengthening the national priorities of each of the developing countries, the technological revolution in the offing will lose much of its steam. The onus rests on the biotechnology industry to adapt itself to the growing needs of the developing countries so as to emerge as a harbinger of growth and sustainable development.

Increasing productivity through higher yield crops, and new geographical locations for crops (such as arid areas and marginal soils) is also being attempted, although there still remains doubts about the trustworthiness and reliability of such engineered products. More importantly, the focus of research is still geared towards loss of biodiversity. A number of ethical and equity issues relating to proprietary rights and access to small farmers to new technologies and markets and its effects on displacement of traditional products like vanilla or the use of land for non-food crops and the effect on non-food crops on the global food supply remain to be answered.

The demon seed : The battleground for biological warfare has now shifted. It is now the turn of Indian farmers and for that matter farmers in developing countries to face the fury and onslaught of genetically engineered seeds. Exercising complete monopoly control through patent rights in 80 countries, the multinational seed industry is now poised to unleash its latest weapon.

In a recent development, the United States Department of Agriculture (USDA) together with one of the biggest cotton seed companies, Delta and Pine Land Inc., have patented a jointly developed technique that enables seed companies to switch on-and-off a plant's reproductive processes. This means that farmers will get a good crop in the first year of sowing. But if they try to save the harvested seed for replanting, the crop would be sterile. In other words, farmers will be left with no choice but to buy seed afresh for every sowing.

Still more worrying is that the genetic engineering technique can be easily manipulated to reduce crop harvest in any given year. Depending on what the commercial interests of the seed company and its food exporting allies is, crop production can be programmed thereby threatening the food security of the country.

Delta and Pine Land has already announced its intention of applying this technology -- aptly named ‘Terminator’ -- to staple food crops like wheat, rice, and sorghum by the year 2004, primarily targeting markets in the developing countries. Considering that in countries like India, where only ten per cent of the 550 million farmers buy seed every year, ‘Terminator’ will rake in a massive windfall for the seed companies. Crops that are difficult to hybridise, mainly self-pollinated crops like wheat and rice, generally ignored by the seed companies because of the low-profit potential, will now receive utmost attention.

The USDA spokesman, Mr Michael Ruff, accepts the downside for farmers as they may be forced to pay more for seed stocks every year. He says that for the USDA what is of paramount concern is an adequate protection of its emerging multi-billion dollar biotechnology seed industry. Delta and Pine Land has, on the other hand, already successfully incorporated ‘terminator’ gene into tobacco. Although, seed multinational Monsanto, which tried to buy Delta and Pine Land, has repeatedly said that the fears over ‘terminator ’ are misplaced since the patent is only for a concept, the fact that the company has already applied for a patent in 80 countries is indicative of its hideous designs.

At the same time, Monsanto has finally announced that it has no intention of any commercial use of the terminator gene. But still, the USDA remains conspicuously silent about the patent rights that it holds for the terminator gene. But more recently, it has been found out that as many as 132 research trials in the US and Europe contain the terminator gene !

While the terminator threat still looms large, scientists working for Swiss food giant Novartis have developed and patented a method for 'switching off' the immune system of plants. Now if you are wondering as to what this implies, let me explain. Novartis has actually developed a technique for disabling the plant’s immune system thereby making it susceptible to more disease attack. The more the diseases, the more will be the sale of pesticides and chemicals being marketed or licensed by the company.

Now, how will the technology work? The genetically modifying process involves transferring a single DNA molecule, described by the company as the 'NIM gene', to the plant. The gene will then react with the plant's immune system, disabling it and allowing it to be switched on only when a particular brand of chemical is applied. As per news reports, the patent also describes plants where the entire immune system has been switched off, making them highly prone to diseases. And yet, a Novartis spokesperson wants the world to believe when she says: “we are only trying to help farmers, not hinder them. We are looking at ways to improve the way plants fight disease.”

Well, if Novartis is so keen to help farmers, the best way is to produce genetically modified plants that have a still stronger immune system. If Novartis can develop a technology that can “switch off” the plant’s immune system, it sure can come up with a gene modification that makes the plant resistant to all diseases. But then, if the USDA is not willing to help the Third World farmers, it will be highly unrealistic to expect a European multinational to work for altruistic gains either.

Farmers Rights have been considered to be an expression of the contribution of farming communities to their innovative capacity as breeders, users and managers of biodiversity. Since they have the right to benefit from the biological resources and related knowledge, their right to save, exchange, and improve seeds is therefore inalienable. The new technology, which may be applicable to all crops in future, will take away the inherent right of the farmer to save seed for future plantations. And therein lies a grave threat to the future of not only Indian but the entire Third World's agriculture and food security.

That genetic engineering is being used primarily to increase the profit margins of the seed and biotechnology companies was known. Earlier, seed companies had dovetailed pesticides and fertiliser research to produce herbicide-tolerant crops that would require farmers to purchase a particular brand of agro-chemical along with the seed. But that the private seed companies will go to the extent of manipulating biotechnology research by tampering with the genetic make-up of the crop seeds aimed at a 'sustained' flow of huge profits, has however come as a rude shock. Unless the developing countries rise against this terribly dangerous application of the 'cutting-edge' technology, seed companies will play havoc with the farming systems.

In fact, for quite some time now, knowing well that Farmers Rights are not compatible with the intellectual property rights systems based on private monopoly control, the US had been keen to derecognise Farmers Rights. It had, therefore, not allowed international deliberations to proceed beyond treating Farmers Rights as a "concept" thereby rendering the talks ineffective. At several FAO meetings, the US deliberately tried to create confusion by endorsing the distribution and commercialisation of farmer's varieties but at the same time insisting on quality standards of existing seed legislation. As most farmer varieties are characterised by diversity and variability rather than uniformity, such an ambiguous stand is in reality a retrograde step.

Such was the defiant stand that the technical advisory committee of the Convention on Biological Diversity, which met at Montreal in September 1996, too could not reach a conclusion on the vexed issue of Farmers Rights in the light of the discussions being focused on genetic erosion in agriculture. The only conclusion arrived at was that a paper was allowed to be presented at the November 1996 Buenos Aires meeting "reflecting the diverse views and suggestions". At the Fourth Technical Conference on Plant Genetic Resources for Food and Agriculture, held at Leipzig in Germany in June 1996, the US had completely blocked any move towards developing Farmers Rights.

At the World Food Summit in Rome, the US emphasised the role of trade in meeting the challenges of food security. Industrialised countries are, in fact, in not willing to talk in favour of farmers. The OECD has reiterated time and again that interpretation of the trade agreement by any other forum than WTO is out of question. And WTO does not recognise Farmers Rights. In other words, after having lost its farming society, the west is keen to let free trade destroy the strong foundations of sustainable agriculture and crop husbandry in the developing countries.

A beginning was first being made by launching an all-out assault to take away the rights of the farmers. And since this did not happen, the US has found a technological

way to eliminate the rights of the farmers in the developing world. In any case, the GM technology will lead to a further round of intensification in the food industry. GM technologies are likely, particularly in the context of the WTO, to further speed up the structural change in agriculture and food supply, making it more difficult for small farmers to stay on the land. Many of these structural changes would be irreversible in generational terms. For the poor farmers, the new frontier of private biotechnology may spell doom.

Patently unfair: The American interest in forcing the developing countries to comply with the TRIPs Agreement is clear – to protect its emerging biotechnology industry from sharing the benefits with the countries from which they drew the plant, animal and human germplasm. And it is primarily for this reason that it continues to drag its feet when it comes to ratifying the Convention on Biological Diversity (CBD), which came into existence in 1993 and till date has been ratified by 178 countries. Ironically, the US is the only country, which has refused to ratify it.

The CBD has for the first time recognised that plant and animal genetic resources are no longer mankind's heritage but a national property, calling for "fair and equitably sharing of the benefits arising out of the utilisation of genetic resources." It, therefore, makes it mandatory for the industrialised countries, to share equally the benefits from any accruing technology, to the countries from which the resources were taken. No wonder, while the US continuously castigates India for its wilful infringement of US patents to the tune of US $ 120 million a year, it never talks about the misappropriated genetic wealth from the developing countries – estimated at US $ 5.4 billion a year, a significant proportion of which comes from India alone !

It is a mad race. Indiscriminate patenting of indigenous plants, animals and even microorganisms continues unabated, throwing the patenting criteria of novelty, distinctiveness and non-obviousness to wind. Already more than 5,000 patents have been granted on genes and cell lines. More recently, the US-based Biocyte Corporation, has been granted a European patent (EP 343 217) on the blood cells of the umbilical cord of foetuses and the newborn. The patent holder has done nothing except show that these cells can be isolated and deep-frozen. And the patent gives Biocyte/Avicord monopoly control over the extraction and use of the cells and over any therapies developed in connection with them. Further, the patent does not require the consent of the subjects from whom the cells are taken.

With biotechnology companies going ahead with patenting of human parts and organs, and at the same time seeking complete control over the human genome, human beings may soon lose control or all ownership rights over their own bodies. A US company, Incyte, has already applied for patents on 40,000 DNA segments and genes in the human brain after the initial discovery was done by a public sector research institute under the well-known Human Genome Diversity Project. The Project is scouting the genetic make-up of 77 Indian communities, including Brahmins, gowdas and jats. And once the Indian communities lose control over their special genetic characters, gene therapy applications will become prohibitive.

It certainly is a classic case of an economic hijack. With the entire food supply system patented by a few multinational companies, India's food security will depend upon the profits that these companies can garner. Since India offers a unique diversity and

richness in food products, there is virtually a worldwide scramble to patent every thing and anything that is part of the Indian food chain. From microbes to animals, from *chutneys* to parboiled rice, and from *idlis* to vegetable *pulao*, food pirates are scouting for anything that is worth intellectual property protection.

After the much publicised patenting of *basmati* rice and Darjeeling tea, comes the shocking news of an American company obtaining a process patent on piperine, a by-product of black pepper, a major forex spinner. What is more damaging is that the patent holder is now set to stop the exports from India. The US-based Sabinsca Corporation has served a legal notice on a Kerala firm claiming that it has a 1996 patent for a formula using peperine. While the patent over peperine has shaken the Spice Board, George Williamson Ltd., of England has filed for a patent on the entire manufacturing process of tea, from the plucking of leaves to its final packaging in chests, prompting the Tea Board to launch an offensive to counter the monopoly control over a process that has been in vogue throughout the country.

Multinational Nestle already has a European patent on vegetable *pulao* and parboiled rice. Innumerable applications are pending before the Indian Patents Office to grant exclusive marketing rights for patented products that range from *chutneys*, jam spreads, ice-cream contents, to 'nutritional meals'. With 64 patents drawn on various insecticidal and medicinal properties of *neem*, 34 patents on tamarind, 11 on turmeric and at least 28 soil micro-organisms already under monopolistic control of a handful of private companies, MNCs intellectual property agenda is no longer hidden. Thanks to the prevailing ignorance and the growing patent illiteracy that we actually do not know how many patents have been granted on Indian bio-resources and food products.

This reminds of another controversial patent that was struck down by the Indian Patents Office in October 1994. This patent, granted in complete contravention of the Indian laws, provided the seed multinational, Agracetus, at that time wholly-owned subsidiary of W.R.Grace Inc (of the neem patent fame), complete monopolistic control over all forms of genetically-engineered cotton, irrespective of the origin of the germplasm or the technique adopted to improve existing varieties. Terming it as "prejudicial to public interest", the patent was struck down in India.

Prejudicial it certainly was, as the patent was unprecedented in nature. In simple terms, it allowed Agracetus the sole legal ownership of any and all cotton varieties evolved through biotechnology and genetic engineering. To put it plainly, the broad-spectrum patent could have easily prevented any further cotton research in India. The striking down of the cotton patent has not removed the threat. Reports of a multitude of similar industrial patents on numerous plant species have meanwhile poured in, threatening not only India's food security but also the livelihood of millions of farming families.

Equally worrisome is the manner in which the US Supreme Court brushed aside two other laws -- the Plant Patent Act and the Plant Variety Protection Act, which many thought were the only route for seeking patent protection for plants and plant varieties. The court rejected the argument that patents for plants reproduced from seeds were not authorized under section 101 of the federal patent law. By a convincing 6-2 margin, the US apex court finally concluded that the patent law

authorizes patents for sexually reproduced plants. Such a patent protection would be available for 20 years.

It is not that the 'utility patents' were not in vogue earlier. Already hundreds of utility patents had been granted to seed multinationals like Monsanto and Pioneer Hi-Bred International Inc. Although the US Justice Department had earlier warned that limiting the scope of the federal law to exclude sexually reproduced plants would reduce incentives for research and development in agricultural and horticultural areas, the fact remains that such 'utility patents' have been the greatest hurdle to crop improvement.

There is this classical case of a 'utility patent' over a hybrid maize variety. At the time when the International Center for Maize and Wheat Improvement (CIMMYT) in Mexico made available the semi-dwarf improved varieties of wheat to the developing countries, literally sowing the seeds of green revolution, a single-cross hybrid variety of corn was denied to India. This variety, which was responsible for the growth of the corn sector in America, was covered under a 'utility patent', and therefore was never made available to India. With the result that despite India being the seat of the green revolution, maize production never really picked up.

The number of utility patents issued has grown up very rapidly in the US. By December 1994, 324 Utility Patents had been issued for new plants or plant parts and 38 were issued for animals. As with PVPC's, most utility Patents were awarded to the private sector (Fugile, Klotz, and Gill, 1995). Thus, IPR has encouraged the private sector to develop new agricultural technologies by enabling firms to capture greater share of the commercial value of their inventions.

But still what is equally more worrisome is the speed at which life sciences firms are drawing patents over genes, gene sequences and cell lines. For instance, Monsanto owns US patent (No: 5,159,135) which covers all GM cotton but there are 228 other cotton gene sequences patented too. *The Guardian (Nov 15, 2000)* reports that there are 25 patents on pineapple, 25 on raspberries, 21 on grapes, six on kiwi fruit, 11 on oranges, nine on apples, eight on pawpaw, four on strawberries and cherries, two on grapefruit, one each on tamarind and peach. There are also 43 patents on silk genes, including several on the golden orb-weaving spider, which makes the strongest and finest thread.
The report goes on to say that although wheat is the greatest hope for mankind, gene companies have already drawn patent on 228 gene sequences. Genetically modified wheat is still far away from the market. Meanwhile, 152 patents have been applied for on rice. Those patents cover 584 genes or partial gene sequences. US Multinational Dow has applied for patents on 655 maize gene sequences, which is 30.3 per cent of the total number of applications. Du Pont has applied for another 587, Affymetrix (US) for 418, Monsanto for 102, AstraZeneca for 83. The top five maize companies have nearly 85 per cent of the total 2,181 applications between them.

Much of the focus is on cereal crops with huge global commercial value like rice, maize, wheat, millet, sorghum, soya and cassava. Patent protection by agri-business companies now covers many of their genes and gene sequences, compounds and properties. And all this will have profound impact on the future of agricultural research in the developing countries. Let us see how.

Rice is one crop, which is known to originate from the Indo and the Japanese regions. It is primarily for this reason that rice is broadly classified into two categories: *indica* and *japonica*. The name is itself indicative of the regions from where that particular kind of rice originates from. But unfortunately, the origin of rice provides no special provision for agricultural scientists. The Indian Council for Agricultural Research (ICAR), world's second biggest farm research infrastructure in the public sector, had recently bought a cloned rice gene from Japan at a cost of Rs 30,00,000. The gene was inserted in the rice varieties but failed to show positive results. It was then inserted in eggplant knowing well that it would not work properly.

If in future the ICAR is to purchase genes for rice from foreign agri-business companies and institutes, the future of developing countries research is at stake. For the public sector, which is finding it difficult to provide salaries to its scientific personnel, buying genes at a prohibitive cost for biotechnology research will only block future research. With product and process patents in agriculture already coming into vogue, the world is fast heading towards a scientific apartheid in the Third World.

It is a matter of time before some of the world's most important crop species and animals become the personal property of a few multinational companies. The plant breeders' rights and farmers' privilege that are being suggested through the alternative *sui generis* system being prepared will then become infructuous.

Genetic pollution: In the midst of all these promises that continued to be doled out faster than the time it takes an email to reach its destination, the world is fast moving into a stage when the rich biodiversity, the hope for mankind's future needs, gets contaminated beyond repair. Sadly, the same scientific community, which had earlier made strenuous efforts to preserve the unique genetic wealth, is today equally indifferent to the dangers of indiscriminate genetic contamination. The Food and Agriculture Organisation of the United Nations (FAO), for instance, had earlier stated: "genetic diversity per se is valuable in that it evens out yield variability, provides insurance against future changes and is a 'treasure chest' of as yet unknown resources." It accepts that plant genetic resources are seriously threatened with erosion "the consequences of which will be serious, irreversible and global

Following the grave genetic mix-up with Bt corn in Mexico, among the major centers of diversity for maize, the International Maize and Wheat Improvement Centre (CIMMYT) in Mexico, one of the 16 international agricultural research centres being run by the CGIAR, was the one to defend the contamination. Asserting that such contamination would not spell doom, it said that diversity could actually increase as a result. "And if plant scientists find a desirable trait in a contaminated variety, they can easily breed plants that contain the desired trait but lack the Bt gene." (*New Scientist*)

CIMMYT's defence of the genetic contamination in the heartland of genetic diversity for maize in Mexico, is a clear pointer to the alarming breakdown in scientific discourse. In fact, *CIMMYT's* assertion is in complete variance with the principles of conservation and utilisation of plant genetic resources. It was primarily for this reason that the CGIAR centres are engaged in collection, storage and conservation of plant genetic resources in genebanks. World food security depends to a large extent on the 30 crops species that provides most of the dietary energy or protein and in particular

on the three crops – wheat, rice and maize – that together provide more than half. Other major crops, such as cassava, sorghum and millet, are also essential to food security, particularly for resource-poor people. Genetic diversity within all these species is important for their continued stable production.

If genetic diversity can be made to 'actually increase' as a result of genetic contamination -- the argument that *CIMMYT* forwards -- and thereby 'make the overall mix that little bit richer', isn't it time to overhaul and possibly disband the international effort by the FAO, the CGIAR and the multitude of plant genetic conservation centres to collect and store the available plant variability? Agricultural scientists have made tremendous effort in the past two decades to make global *ex situ* collections of over 6 million plant accessions. This all began when the FAO recognised the threat posed by genetic erosion and set up the Panel of Experts on Plant Exploration in 1963.

The number of storage facilities has increased dramatically over the past two decades. Before the Second World War, the earliest plant germplasm collections were started by the legendary scientist, N.I.Vavilov, in the former Soviet Union. By 1970, there were about 54 seed stores, of which 24 had long-term storage capacities. Today, there are over 1,300 national and regional germplasm collection centres with many countries having a number of storage facilities. In India, for instance, which has one of the largest plant collection activities, collections are stored at 70 different locations. Hundreds of millions of dollars are being raised every year to maintain the viability of these collections, knowing that any lapse would be suicidal for the humanity.

Given the importance of wild and semi-wild food plants to the livelihoods of many poor communities, an additional effort is also being made to conserve these species in Protected Areas. In Mexico, genetically unique wild populations of perennial maize are being specifically conserved in a small portion of the Sierra de Manantlan Biosphere Reserve. The importance of this collection can be gauged from the fact that in Mexico only 20 per cent of the local varieties of maize known in the 1930s are now cultivated. The decrease in the land area planted with maize and the replacement with other profitable crops has already resulted in serious genetic erosion in corn. How much damage the Bt maize contamination has inflicted on the limited genetic diversity that exists, is something that should be a cause for worry.

For some strange reasons, the CGIAR has refrained from commenting on *CIMMYT's* unscientific claim that such contamination actually adds to the available genetic diversity. If *CIMMYT*, which houses the world's largest collection of wheat and maize germplasm, remains unperturbed at the pace and speed at which genetic contamination is growing, isn't it time to take a fresh look at the policy to conserve plant germplasm? After all, if genetic pollution 'actually increases' available diversity, much more biodiversity can be added to the world's decimating genetic wealth by encouraging genetic pollution. Why seek tax-payers money to maintain plant genetic collections globally when more efficient results can be achieved by allowing for indiscriminate genetic contamination?

To say that genetic contamination is nothing to be worried about, is to debunk the understanding that old varieties and wild relatives of crop plants are a valuable resource for researchers and farmers, and are disappearing fast. Genetic erosion

coupled with genetic pollution will destroy that unique genetic base and thereby create an unforeseen crisis on the food front.

The biotechnology industry, however, is not even remotely concerned. "It is better to acknowledge that a minimum of cross-pollination cannot be avoided, and not to panic," Guy Poppy of the British Biotech Association had told the British science magazine, *New Scientist*. Amidst growing incidences of genetic pollution world wide, orchestrated campaigns at the behest of the industry have already browbeaten the governments to accept genetic pollution as inevitable. Governments have been made to believe that the likelihood of such 'inadvertent' genetic contamination in future will grow along with the increasing number of GM crops being grown around the world.

Genomics and hunger: Agricultural scientists are visibly excited. After all, the mapping of the rice genome – the genetic map of the rice plant -- announced by multinationals Syngenta AG and Myriad Genetics Inc. appears to be a vital tool for boosting yields and relieving world hunger. And for agriculture scientists and policy makers, who are officially committed to alleviating hunger and malnutrition, this is obviously a cause for cheer.

Senior officials of the Food and Agriculture Organisation of the United Nations (FAO), have been quoted as saying that the technological breakthrough "will provide us an additional tool to increase food production in the next 20 years as the population rises," adding, "food could become more affordable to the poor people who consume it."

The task of eradicating hunger will now become a distant dream. After all, the world is known to be dependent upon rice as its major staple food. Now a multinational company has announced that it alone controls the rice genetic structure. The companies that have mapped the rice genetic map will not make it freely available to researchers in the developing countries, thereby restricting the development of improved rice varieties.

Golden Bluff

Ostensibly, in a desperate effort to repair its damaged credibility, the biotech industry is all set to unleash its "secret weapon" and that too on millions of unsuspecting destitute smallholders in the developing world.

But what is not being understood is that like all other "secret weapons", the 'golden rice' too is an ecological and health hazard. Nor is it the answer to the nutritional needs of the small producers and the poverty-stricken masses in the South. It can provide at best a maximum of 15 to 20 per cent of the Vit A needs of a consumer. The remaining intake will have to be met from other nutritional sources. In India, for instance, rice is consumed invariably with a combination of pulses, which provide the essential proteins and vitamins that the human body requires.

It is still not clear as to who decided that Vit A is the most essential micro-nutrient that is required to be incorporated in rice? And why not Vit B complex? After all, several hundred million people in India alone suffer from malnutrition (as compared to only half a million people worldwide who get blinded from vitamin A deficiency). Moreover, the US National Academy of Sciences recently came down heavily on the intake of vitamin pills in North America, categorically stating that this is doing more harm than good. What is the guarantee that the person who consumes 'golden rice' thrice a day will not face the same problems?

If Vit A is required, why follow the risky and unproven genetic engineering route? In India, some companies are fortifying table salt and wheat flour with vitamins. Since table salt is part of the daily diet in the Third World, and is also required in small quantities, isn't this a much safe and economic way of reaching the unreached and also blending it with philanthropy? Fortified table salt costs on an average Indian Rupees eight a month (about ten British pence), which every poor family can afford. 'Golden rice' will not be within the reach of the poor. Already, the price of rice in India (in 1999-2000) has risen by 60 per cent as a result of which millions of people are unable to ensure two-square meals a day.

"Golden rice" is in reality a blind technology, whose aim is to distract attention from more pressing problems confronting the rural society. A majority of the acutely malnourished people, that the proponents of 'golden rice' claim to be targeting, are the ones who cannot afford to buy rice from the market. If they are able to buy or get adequate quantities of rice to meet their daily requirement there would be no malnutrition at the first place. The problem, therefore, cannot be addressed by providing nutritional supplements through genetically modified rice but by bringing in suitable policy changes that forces the governments to ensure food for all.

FAO has also been repeatedly telling us that there are about 800 million people who go to bed hungry every night. A third of these acutely malnourished and hungry, an estimated 320 million, live in India. And if India alone were to launch an all-out attack to remove hunger much of the world's hunger problem would be resolved. On the other hand, in the South Asia region, the hunger situation is even worse than sub-Saharan Africa. Together, the seven nations of the South Asia region are inhabited by more than half the world's hungry population.

It also remains a fact that the rice yields in the South Asian countries, including India, are amongst the lowest in the world. In India, for instance, if we were to exclude the rice productivity in Punjab, Haryana, Andhra Pradesh and Tamil Nadu, the yields would hover around one tonne a hectare. In any case, even by including the higher yields in the green revolution belt, the rice productivity averages at about two tonnes. This is pathetically lower than the high rate of productivity, exceeding six to seven tonnes a hectare, in neighbouring China. So even without incorporating the 'cutting-edge' technology, as genetic engineering is profoundly called, there exists tremendous scope to multiply production (at least by three times) by simply improving the management of the crop farming systems.

At the height of the paddy harvesting season in September 2000, hundreds of thousands of farmers in the frontline agricultural states of Punjab, Haryana and western Uttar Pradesh, in northwest India, had waited for three weeks before the government agencies were forced to purchase the excess stocks. For three weeks, farmers sat patiently over heaps of paddy in the grain markets. At least 25 farmers, unable to bear the economic burden that comes with crop cultivation, preferred to commit suicide by drinking pesticides. In Andhra Pradesh, in south India, there were no buyers for the five million tonnes paddy surplus. Even in the poverty-stricken belt of Bihar and Orissa, in north-central India, farmers waited endlessly for the buyers.

Paddy procurement in India hardly got off the ground. Farmer's suicide is perhaps a reflection on the breakdown of institutional safety nets, which in the past have cushioned the impact of agrarian crisis. Farmers can no longer turn to banks and

credit societies for loans and procurement support; the public distribution system no longer offers food supplies at substantially subsidised prices; and market intervention is only partial – a combination of frustrating circumstances.

Andhra Pradesh has publicly asked farmers not to produce more paddy. In Punjab, the citadel of green revolution, farmers are being asked to shift from staple foods like wheat and paddy to cash crops. And yet, agriculture scientists want farmers to produce more food. Isn't it therefore something terribly wrong with the way the scientists and planners blindly supports biotechnological breakthroughs, which in turn can eagerly pushes farmers into a suicide trap?

The paradox of plenty is not only confined to India. Pakistan, Bangladesh and even Indonesia are overflowing with foodgrains. Pakistan had a surplus of two million tonnes in 2000. Bangladesh, a chronically food-deficit country, had announced embargo on rice imports a couple of years back. All these countries are, however, waiting for another impending disaster – what will happen to the very survival of the farming communities when cheaper foodgrain imports under the WTO have to be allowed?

Rice genome mapping cannot address the real issues of access and distribution that results in hunger. Genetic engineering, and more through cosmetic pills of Vitamin A-enriched rice and herbicide-tolerant plants, will in reality exacerbate the existing crisis confronting the agrarian sector in the rice-eating countries. With stringent intellectual property rights designs and resulting monopolisation such technologies will only shift agriculture under the control of private companies.

Further, in India, which is "self-sufficient" in foodgrain production, reports of hunger and starvation pour in regularly from the infamous Kalahandi region of Orissa on the western coast. The region, with a population of 20 million, suffers from the pangs of hunger and malnutrition despite any visible signs of ecological devastation. Kalahandi is otherwise a fertile tract and has traditionally been a basket of food. So much so that in 1943, at the time of the Bengal Famine, Kalahandi had come to the rescue of the famine stricken Bengal !!

The problem is certainly not of production. What is not known is that Kalahandi region is the biggest contributor of surplus rice to the central food reserves. For the past five years, 1996-2201, Kalahandi has been providing some 50,000 tonnes of rice on an average to the food reserves of the government of India. Why people die of starvation and hunger is not because there is not enough food but because they cannot afford to buy the food they produce. Biotechnology has no mechanism to ensure that food comes within the reach of these poorest of the poor.

And in India, an estimated 320 million people are below the poverty line with a monthly income not exceeding US $ 400. In 1999, the country produced a bumper harvest of wheat, some six million tonnes more than what it produced a year before. It already had a carryover stock of four million tonnes. In total, therefore, the country had a "surplus' wheat stock of ten million tonnes. Aware that at least 250 million people live in abject poverty, still the government had allowed the surplus stocks to be exported.

In the year 2002, India had a record food surplus of 60 million tonnes (came down to 48 million tonnes in early 2003), including 24 million tonnes required for the buffer. Ironically, while the Indian government is asking its farmers to diversify from rice and wheat cropping systems to cash crops, the National Agricultural Policy has projected an annual growth rate in foodgrains at four percent to meet the growing food requirements in the years to come. Unmindful of what the agricultural scientists and the policy makers say, the government is slowly but steadily dismantling the procurement system and the pricing policy that have been an effective instrument in ushering in food self-sufficiency following the green revolution.

With globalisation force opening the country's huge market for food imports, and with genetic engineering monopolising the development and production of staple foods, the shape of agriculture in the developing countries is sure to undergo a massive change. Agriculture will no longer be the mainstay of the developing economies, the main source of livelihood security for millions of small and marginal farmers. Food for the hungry millions will come from the precision farms of the western countries. What happens in turn to the survival of millions of people banking upon agriculture for their livelihoods is nobody's concern. #

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