

Paradigm jump in Indian agriculture: natural or coercive?

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Interpreting Vedic literature at mundane (*adhi bhoutic*) level, we find reference to agriculture as a cultural and divine activity. Harmony with nature, and the expression of gratefulness to mother earth for bestowing on us the fruits of our labour nurturing her, constitute the core elements of the agrarian tradition in India. Today, faint imprints of this tradition exist in the form of religious celebrations at the time of harvesting in rural India. However, a discontinuous jump in the paradigm of Indian agriculture seems inevitable due to a monolithic US-propelled globalization; unless, of course, we recognize the intrinsic strength of the age-long value system, and articulate a challenge to the institutionalization of monopolism represented by the World Trade Organization (WTO), the World Bank (WB) and the International Monetary Fund (IMF). Exploitation of natural resources and human beings motivated by greed, and the ownership of wealth – material as well as intellectual, concentrated amongst a few individuals or multinational corporations (MNCs) are fundamental to this monopolism. In India, majority of the people depend on agriculture for their livelihood, and most of them are poor and marginal farmers. Issues like intellectual property rights (IPR) and transgenics are not just of academic interest: an entirely new value system is threatening the very existence of the farmers in India. Unlike America where this system evolved naturally, here we are coerced to follow the US-led agenda. Let me try to elaborate.

The industrial revolution of the 18th century also affected agriculture and slowly, its irreversible effect was visible due to large-scale machine farming, truck-tactor industries, chemical fertilizers and pesticides, and high-yielding varieties. It has been estimated that less than 5% of the families in USA lived on farms in early 1970s compared to about 60% a century ago. Emergence of agro-industries and MNCs on one hand and the environmental and health-safety issues on the other dominated the US agriculture scene for few decades. The Plant Patent Act (1930) in USA gave rights to breeders of some asexually produced

plants. The US scientists and farmers rejected patents to sexually reproduced plants on 'the ground that it would inhibit the free exchange of genetic materials and lead to excessive concentration of proprietary control in seed industry'. Gradually the influence of seed corporations increased and the PVP Act (1970) enlarged the scope of the 1930 Act. The discovery of the DNA molecule and advances in genetic engineering led to the hope that traditional plant breeding could be revolutionized employing bacteria-controlled nitrogen fixation and developing disease- and pest-resistant transgenic plants. Obviously, this approach held hope for environmentalists too. Meanwhile, in the 1970s, two perceptible changes occurred in the US – government funding for research and development was declining, and the commercialization of knowledge was damaging the cause of public good and social obligations. In 1980, the 1970 PVP Act was amended under pressure from the MNCs. Agriculture scientists expressed the apprehension that it will lead to patent monopoly of seeds, high prices in the developing countries, and loss of the existing plant varieties. The MNCs were wary of the fact that the basic germplasm diversity being located in the Third World, they might be refused access. The reader may find some articles (ref. 1) and discussions in (ref. 2) on these issues quite informative.

The information revolution³ is also being exploited by the agri-biotech corporations. In recent years, the MNC lobby seems to have become all powerful in the US. The world's biggest agri-biotech corporation, Monsanto, owned maximum number of patents on transgenic plants granted between 1985 and 1995. An unethical collusion of this company with the legal institution Codex was reported few years ago⁴. A recent case is much more alarming⁵. A new *Bt*-maize to fight the European corn borer has been developed by Monsanto. The company wanted its farming in the US; however, it is the pesticide treatment for the corn root-worm that costs farmers a billion dollars per year, and since the new *Bt*-maize is not resistant to this pest, a scientific review board comprising 14 members ex-

amined this issue. In October 2002, the majority (11 out of 14) of the board members recommended that the new *Bt*-maize could be grown if the farmers planted an equal area of non-transgenic maize next to it. Unfortunately, the commercial interest of Monsanto prevailed over the public interest, and the US Environmental Protection Agency in a 25 February 2003 decision rejected the recommended stipulation of the review board. Control of genetic information and the application of information technology in business are the prime goals of big corporations; stringent IPR laws and promotion of heavily funded R&D are the means to achieve them. A new form of imperialism termed as 'information feudalism'⁶ is emerging.

Ironically, this model has not proved beneficial to the American people themselves: affluence of a few and a sharp rise in inequality, relegation of social welfare and public good into the background, and appropriation of the legal system by big corporations are becoming too manifest. Once the US Supreme Court approved the patenting of a genetically engineered bacterium in 1980, greed and legal manipulations have become the main factors for patenting microorganisms. Academic freedom and free flow of new knowledge in the pursuit of science have come under severe stress.

The Uruguay Round of GATT (General Agreement on Tariffs and Trade) negotiations that began in 1986, for the first time incorporated non-trade aspects like agriculture and IPR, and the draft proposal (Dunkel draft) represented the agenda of WB-IMF-MNCs. An equitable share in the techno-economy does not seem possible with the creation of WTO outside the UN system. Numerous studies have established that the Indian response was characterized by the lack of transparency and strategy, and a sense of resignation. Are we any better to articulate our interests after nine years of the establishment of WTO?

Amongst the scientific community there is some awareness on the complex issues, though it is inadequate. In a recent welcome initiative, a special section on transgenic crops has been brought out by

*Current Science*⁷, and hopefully there would follow 'an earnest debate on transgenics in Indian agriculture' as Pental puts it⁸. I would briefly comment on some salient points with a different perspective, and offer insights into some missing or contentious issues. In the light of preceding remarks on the US model, I would argue for a radically new approach.

The 1960s were the days of acute food scarcity; and therefore the adoption of the US model seemed to have some justification; the ensuing period in Indian agriculture has been called the Green Revolution (GR). GR is rightly credited for food surplus; however its negative effect on the environment and health has also been recognized. If we carefully reflect on the scene during the GR, then the aggressive role of agro-chemical corporations promoting this model becomes obvious. At that point of time, it had become well established in the US that excessive use of chemicals in agriculture had led to environment and health hazards, and as noted earlier, resulted in the reduction of the percentage of farmers. Our scientific leadership and policy makers failed to learn from the US experience, and a short-sighted approach was taken. Fortunately, in those days, socialism and cooperative movements were alive that saved wiping out of the small farmers; however the cottage industries practically vanished, and the working days in rural areas became greatly reduced, there by ruining the village economy. Repeating the same mistakes in the fast-paced era of biotechnology and the growing danger of unilateralism in the garb of globalization would be catastrophic. The role of the nexus between MNCs, powerful NGOs, science-managers and policy makers in pushing the transgenics and WTO agenda has to be clearly understood in any meaningful debate.

Let me quote from the vision 2001 document of the Indian Science Congress (ISC): 'By 2020, India will be free of poverty, hunger and malnutrition, and become an environmentally safe country'. Biotechnology is projected to meet the challenges of feeding the growing population of India, and provide nutritional security, by Paroda⁹. James also advocates transgenic crops for similar reasons¹⁰. Note that unlike the crisis in the 1960s, now the impending population explosion and the extrapolation to future crisis have become keywords to sell transgenics technology. Why do people

not get food today in spite of the surplus of foodgrains? Let us not fall prey to commercialization of hunger; Atteri says candidly that transgenics have nothing to do with helping the developing world to produce more food¹¹. James presents data to show that planting of transgenic crops has vindicated the 'vision of the pioneers', and that global food security in future and the alleviation of hunger in the Third World are the compelling reasons for biotechnology. He mentions that small and resource-poor farmers had access to transgenics and derived economic benefits; but he does not provide specific data. Argentina is listed as the second largest transgenic crop-growing country (Table 3, ref. 10). In contrast to the rosy picture painted by James, a report on the ground reality in Argentina by Branford¹², makes chilling reading. In 1996, Monsanto introduced 'Round-up Ready' soya, and the company's propaganda led to its adoption by almost 90% of the farmers. According to Branford, though Argentina has become the third largest producer of soya, it has been due to the increased area of land used for transgenic soya crop, and its cultivation throughout the year. The number of farmers has fallen by about 30% over the past decade, the ecosystem has been damaged, new resistant weeds are coming up, and the impoverished families have to depend on imported 'free food baskets'. In India too, the Parliamentary Standing Committee on Agriculture has recently raised serious doubts on *Bt*-cotton crops, and asked for a reevaluation of its viability¹³.

To understand the impact of TRIPS (Trade Related Aspects of Intellectual Property Rights) on agriculture, I analyse Article 27, section 5 of this agreement. Any invention (product or process) in all fields of technology is patentable if it is new, innovative and capable of industrial application. Microorganisms are patentable. Para 3(b) of this article allows exclusion from patents of plants and animals other than microorganisms, and essentially biological processes. Plant varieties shall be protected by patents or effective *sui generis* system. Note that the Paris Convention in the amended version has vastly broadened the scope for the industrial property, including agriculture. As regards to plant breeders' rights, the 1978 UPOV (The International Union for the Protection of New Varieties of Plants) Act permits free use of a plant variety

developed by conventional breeding for farm-saved seeds. However, the revised 1991 UPOV Act makes this provision an optional exception, i.e. a plant breeder may not permit the farmers to save seeds for sowing the second time. UPOV documents admit that for the welfare of farmers and other people, it would be desirable if the new plant varieties are made available free of charge or on a subsidized basis and the research is supported by public/state funds. However, the document further argues that in view of huge funding by private investors in biotechnology, a legal system for reasonable economic return on the investment is imperative. Unfortunately, there is no mechanism to check 'reasonable returns' turning into 'unlimited profit-making'. A vicious circle of costly research, and exclusive proprietary rights of corporations on research results has been set in. TRIPS and transgenics are intrinsically linked.

In spite of the considered opinion of a group of experts and the drug industry that India should not join the Paris Convention, not only has the Indian Patents Act, 1970 been amended, but India has joined the Paris Convention. It becomes mandatory to grant industrial status to agriculture in view of the extended definition of the industrial property in the Paris Convention. The claim by the government that such a legislation is being brought for the benefit of farmers is deceptive: most of the agriculture produce would automatically become patentable. Ironically, TRIPS does not require the member countries of WTO to join the Paris Convention.

Pental⁸, in his article, dwells upon the Plant Variety Protection (PVP) Act of India, and asserts that this would benefit both private and public sectors and also safeguard the interest of farmers. In the suggested policy framework by him (see para 16), the desirability of following this legislation for next 15 years is recommended. There are two important points passingly mentioned by him: (i) about India joining UPOV (1991), and (ii) the role of Convention on Biological Diversity (CBD) in such legislations. His reasoning is too simplistic that 'bad advice' by 'the specialists' is responsible for the decision of the Government of India to implement UPOV (1991) Act. I share my experience with the readers on this issue.

A Joint Parliamentary Committee (JPC) on the Protection of Plant Varieties and Farmers' Rights Bill, 1999 was set up,

and public opinion was sought. On 24 March 2000, there were oral depositions before the JPC at the Parliament House, Annexe, New Delhi. It was surprising that amongst five depositions, two were from Monsanto representatives. I had also deposed before the JPC, and the deliberations are on record, and are the property of Parliament. During an informal interaction with the JPC members and the experts, I got the impression that there was a defeatist attitude: we have to enact a law under WTO obligations. Subsequently, I had circulated an open letter (available with me) to the Members of Parliament cautioning against the design of MNCs.

The crux of the matter is captured by Murasoli Maran in his July 2000 lecture¹⁴: '... There is a proverb that just because the camel knelt down, it was loaded'. Once we accept the distorted and greed-inspired IPR philosophy, the hold of the corporations lobby on all public-interest policy matters will increase exponentially with time: joining the Paris Convention and UPOV demonstrates this.

On CBD, we are fighting a losing battle. The Biological Diversity Act (BDA), 2002 aims at safeguarding the biological diversity of the country, and sharing of the benefits of the commercial use of the public-domain traditional knowledge on the pattern of IPR laws. Though BDA, 2002 draws strength from the CBD, the second part is not stipulated by the CBD, and no international IPR system exists that gives protection rights to the traditional/public knowledge. It is well known that the US does not accept CBD provisions. The BDA, 2002 effectively means nothing as far as the exploitation of biodiversity by MNCs is concerned. However, the establishment of a National Biodiversity Authority would deprive the poor/tribals free access to the bio-resources. Already substantial gene-resources have reached the R&D laboratories/MNCs in the developed world, and smuggling/piracy of whatever remains with us cannot be stopped. Let us recall that in one of rare foresights shown by the science establishment, the goal of documentation and conservation of biodiversity was set in the 1977 ISC, 15 years ahead of the CBD. We failed to act on this, and also did not define the agenda for biodiversity-poor countries. Once we are bound by commitments to the CBD, the urgency for identification and conservation of biodiversity resources is felt by scientists, see,

for example, ref. 15. Though the current thrust on biodiversity resources and community rights for traditional knowledge is projected as a strategy to face challenges under the WTO regime, the involvement of powerful NGOs with MNC mindset in this does not inspire confidence. In fact, the biodiversity databases and registers shall be under the control of NGOs and state authorities. Would a farmer who has been responsible to conserve and nurture germplasm have any real rights? Moreover, this new-found wisdom of the experts and scientists in our country to commercialize traditional knowledge/biodiversity is a poor imitation of the Western concept of 'knowledge is commodity'.

We must learn from the past: WTO is an instrument of economic imperialism, the day its functioning becomes just and democratic, the US will dump it. UN agencies have met this fate, and a report by Knight¹⁶ on the plight of CIMMYT (International Maize and Wheat Improvement Centre) as well as comments in ref. 7 show that support for plant breeding has declined enormously. It would be a crime against the poor and the farmers to implement WTO and globalization agenda. Technology should serve mankind and not vice versa. Let us reflect on the fact whether we are not becoming subservient to information and biotechnology. Information empowerment, knowledge society, transgenics, global competitiveness, etc. are fanciful words juxtaposed with the slogans of a hunger-free world and poverty alleviation. Such a euphuism cannot hide the stark reality that poverty alleviation has been a lucrative business for the past few decades, see, for example, a critique in Hancock¹⁷, and whatever short-term gains – these are going to the upper middle class and the divide between the rich and the poor is widening.

What is the alternative? In the beginning of this commentary, I drew attention to the ancient wisdom. Let me assert emphatically that the solution to complex problems which the modern world is facing lies in reviving the distant past philosophy. The fundamental guiding principle is minimum disturbance to equilibrium in nature, and harmonious living. Cow-based agriculture and the care for sentient and non-sentient beings are the practical realizations of this principle (African and Asian societies in one form or the other have preserved traces of this). I conclude by listing short-term and long-term measures that are feasible.

Short-term strategy

(1) Reversal of the IPR trends. Patents/IPR should be granted to individual innovators and not corporations/institutions. Indian experts may initiate this move at the international level, e.g. in the World Intellectual Property Organization (WIPO). Further, the original meaning of the industrial property envisaged in the Paris Convention should be restored.

(2) We should strive for making WIPO a supreme body on IPR, and seek removal of TRIPS from the WTO.

(3) The Government of India should strengthen public-sector research in agriculture, and no MNC-sponsored research projects should be allowed in the public-funded institutions/universities.

(4) Indian agricultural scientists should make their research results available free of cost. Knight¹⁶ mentions that MAS wheat consortium makes 'marker sequences and research protocols' freely available. Interested readers may visit the website at maswheat.undavis.edu. It would be worth exploring collaboration with such movements cited by Knight.

(5) Transgenics per se need not be rejected on superficial grounds. In view of the proprietary control on transgenics by MNCs and the misleading hype associated with this, there is a need to examine issues like health safety and environmental impact¹⁸, and also to make a comparative study of the so-called value-addition in transgenics with dwarf varieties and the original plants that were grown prior to GR. Research institutes may form core study groups of dedicated scientists for this purpose. The serious limitations of transgenics in the opinion of experts are quoted by Knight¹⁶.

(6) The strength of the traditional knowledge has been its free flow, and lack of the claim of ownership. Let us not waste our time seeking its protection on the IPR model.

Long-term measures

(1) The root cause of poverty appears to be the system in which material value of intellect is exceptionally higher compared to labour. A thorough analysis of optimum valuation of the two needs to be made.

(2) Are the traditional system of cattle-based agriculture, and the small, cottage and village industries best suited for 'happiness to all', or is the high technology-knowledge an economy-based model?

Could there be scientific parameters, e.g. energy (or entropy!) to make an objective assessment? Thinkers and seers have enlightened us through the ages; however, we may plan a systematic investigation utilizing modern science to understand these questions.

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Canopy science and its relevance in India

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Tropical forest canopies are the least explored regions in the world. The estimate on global species richness was drastically revised after a short exploration of forest canopies. Yet, it still remains one of the least understood regions in our biosphere. Many brave researchers in the past have explored these regions with limited accessing capabilities across the globe and have revealed interesting findings on the behaviour of plants and animals. In recent times canopy science, thanks to hi-tech accessibility, is emerging as a new discipline where more interdisciplinary and large-scale research possibilities are forthcoming; canopy-atmosphere interactions, structural and functional aspects of canopy on biodiversity are a few among them. Forest canopy research can also provide inputs to many global-level processes such as climate change. Here, we review the direction that canopy science has taken in recent times in the tropics and also explore the possibilities of pursuing canopy science more intensively in India.

To reach into the rainforest roof is not an easy task, either for man or the giant trees which give birth to small offspring.

– Mitchell¹

Global scenario

The canopies of tropical forests are unique in many aspects with diverse habitats, of which we know very little. These have been recognized as the last biotic frontier and the heart of biodiversity². Much of the biodiversity found in tropical forests is in the canopies. Terry Erwin³, who estimated insect diversity in the canopy through fogging experiments in Central America, revised the estimate of insect species numbers from 5 to 30 million. This has brought the canopy into the limelight of science and has

kindled interest in other parts of the world. Canopy studies in the past and in most parts of the world were hampered by lack of adequate safe-climbing gears to access the rainforest roof. However, this did not hamper the spirits of some pioneering workers in the canopies.

Canopy research started with an initial curiosity of researchers to access and discover what is there in the treetops. A few dedicated researchers operating on shoestring budgets in various parts of the remote tropics have come up with some interesting discoveries from the canopies and have highlighted how little we know about these 'last frontiers'. Elliot McClure⁴ went up a ladder in Malaysia to realize the importance of periodic flowering and fruiting for the canopy-dwelling animal community. Chan and Appanah⁵ revealed for the first time how

minute thrips are important pollinators of towering Dipterocarp trees in Malaysia. Nadkarni^{6,7} and her colleagues in Costa Rica used Single Rope Technique to demonstrate that canopy trees actually put forth adventitious roots that run below thick mats of accumulated organic matter on the branches in which they support epiphytes to supplement their nutrition. After a decade of work in the canopy, Lowman⁸ pointed to the previous gross underestimation in herbivory by ground-level workers and estimated longevity of canopy leaf to span across 4–10 years. Such exciting findings are from *in situ* work of people who have overcome the obstacles of gravitation.

In recent times a range of high-tech equipments such as walkways, cranes, balloons and airships are used to access the canopy. With the commissioning of