

Genetically Modified Crops for Food Security in India: Buddhist Environmental Ethics

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Abstract: Dwindling land holdings, deteriorating natural resource base, change in the consumption pattern coupled with the climate change phenomenon poses challenge to global food security for a burgeoning population. India is one of the most vulnerable countries to climate change. Climate change impacts the yields of various important principle food crops and the crop yield variability will have more adverse effects on food security. Climate change projections raise concerns about future food security and needs for adaptation. In this context, the potential of the Genetic Engineering applications in agriculture caught the imagination of Indian policy makers to address the food security challenge. The Genetic modification (GM) approach to Indian agriculture has generated a conflict with key ethical goals between ensuring food security and trade, farmers and consumer rights, biodiversity, environment, animal welfare, future generations. Questions have also been raised about the nature of the science and democracy. In this paper, I will discuss in detail human health, environmental and biodiversity problems raised in the context of GM brinjal in India. The health and environmental ramifications will adversely affect the well being of both the present and future generations of all living things. Drawing on the two fundamental Buddhist doctrines namely “dependent origination” (Pratitya-samutpada) and “the middle way” as sensitizing concepts, the present paper argues that the climate change adaptation measures in Indian agriculture need to be guided by the principles of Plurality, Relevance, Precaution and Participation as a way to solve health and environmental problems.

Keywords: Genetically Modified crops, Food security, Buddhism, Environmental Ethics.

INTRODUCTION

Dwindling land holdings, deteriorating natural resource base, change in the consumption pattern coupled with the climate change phenomenon poses challenge to global food security for a burgeoning population. India is one of the most vulnerable countries to climate change. Climate change impacts the yields of various important principle food crops and the crop yield variability will have more adverse effects on food security. Climate change projections raise concerns about future food security and needs for adaptation.

In this context, the potential of the Genetic Engineering applications in agriculture caught the imagination of Indian policy makers to address the food security challenge. The proponents of the technology have argued that the adoption of the GM crops is the only solution for ensuring the food security and to solve the present problems in the Indian agriculture. On the other hand, opponents have raised various apprehensions on the potential of this technology around human health and environmental consequences.

Thus, applications of Agricultural Biotechnology in India have proved contentious with the debate spanning a wide range of economic, social, cultural, environmental and ethical issues in addition to the scientific ones.

The primary objective of this paper is to analyse the human health, environmental and biodiversity problems raised in the context of GM brinjal debate in India. Further, I use the two Buddhist doctrines namely *dependent origination* (Pratitya-samutpada) and *the middle way*, as the sensitizing concepts to argue that the climate change adaptation measures in Indian agriculture need to be guided by the principles of plurality, Relevance, precaution and participation and so on.

The present paper is organized into six sections. The first discusses the context of GM Brinjal debate in India. The second presents the Buddhist Environmental Ethics. The third section highlights various health and environmental concerns raised in the

context of GM brinjal. The fourth and the fifth discuss the potential of the GM crops to address the Food security and insights from the Buddhist doctrines for the GM debate respectively. The final section is the conclusion.

GM Brinjal Debate in India

The potential of biotechnology to modernise agriculture wedged the imagination of the Indian policy-makers to address the challenges of food security, malnutrition, arresting the crop loss due to pests, insect and diseases and so on. The first generation Genetically Modified (GM) crops that are presently available are primarily the agronomic traits, i.e. either insect/pest resistance or herbicide resistance. Second generation GM crops, featuring nutritious benefits, better flavour or a longer shelf life might benefit consumers.

The debate around the Genetic Modification (GM) crops entered the public sphere during early 2002, when the Genetic Engineering Approval Committee of India (GEAC) recommended for commercial release of GM Cotton. GM cotton is the only non-edible crop approved for commercial cultivation in India. The areas under GM cotton increased from 29307 hectares in 2002 to 10.8 million hectares in 2012 with an adoption rate of 93% [1].

GM brinjal is the second genetically modified crop and the first food crop which has come so close to commercial release during the year 2009. The GM brinjal in India was developed by Mahyco (A subsidiary of Monsanto). It has generated extensive debate across country. Responding to the public outcry the government had organized public consultations in seven locations across the country. On 9 February 2010, following the public consultations, the then Minister for Environment and Forests (MoEF) Mr. Jairam Ramesh imposed a moratorium on the environmental/commercial release of GM brinjal by invoking *precautionary principle* (see End Note).

Different stakeholders, namely Farmers/Farmers organizations, NGOs, Consumer Forum, Environmentalists', citizen groups, Industries' and scientists/Experts', Students/ Researchers' Government officials, Political/ Elected bodies/ members have participated in the consultations. Center for Environment Education (CEE), an autonomous organization engaged in Environmental and Sustainability Education, was entrusted with the task of organizing and facilitating these consultations and also to summarise the proceedings of the consultations. The data for this study are the statements/ concerns that different stakeholders expressed in these consultations. Proceedings of the public consultations, as summarized by the CEE from public consultation comprise of 631

transcribed propositions made by a cross section of stakeholders' on various themes [2]. For the purpose of the present study, these propositions were analysed by using coding method. Codes are "tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study" [3]. Review of 631 propositions indicates that the Indian discourse concerning GM food crops revolves Biodiversity and Environment, Pest Management, Economy and Livelihoods, Human Health and Biosafety, Approval process and Regulatory process.

Several concerns were raised by the stakeholders on the nature of the technology. As the GM foods are produced using genetic engineering techniques in which "foreign" genes are inserted into the microorganisms, plants, or animals. These foreign genes are taken from sources other than the organism's natural parents. Hence, the ethical objections to GM crops center on the possibility of harm to human health and environment. The important questions raised in this regard are: Is it ethically justifiable to produce genetically modified crops and foods? Should the government allow GM foods to be grown and marketed at the cost of human health and the environmental risks? Is Science only criteria for decision making?

Buddhist Environmental Ethics

The main emphasis of the Buddhist Philosophy is that one should gain insight into the reality of human suffering, diagnose for its causes, and explore the way to eradicate it permanently. In the present day world we encounter a range of environmental problems, such as climate change, reduction in biodiversity, etc. Mahayana Buddhism asserts that all living things including animals and plants deserve respect since they possess the state of Buddhahood.

The ultimate purpose of the practice of Buddhism is to attain Buddhahood (Sat Paramita). In Buddhist thought, there are six kinds of practices by which a bodhisattva attains Buddhahood. The six kinds of practices consist of giving donations (dana-paramita), keeping the precepts (sila-paramita), being forbearing (ksanti-paramita), being assiduous (virya-paramita), practicing meditation (dhyana-paramita), and cultivating wisdom (prajna-paramita). Living with wisdom and upholding the precepts are especially appropriate as ethical norms in Buddhist philosophy.

In this paper, I will discuss health and environmental problems raised in the context of GM crops and examine how two fundamental principles of Buddhism, the wisdom of dependent origination" (Pratitya samutpada) and the wisdom of "the middle way" offer us an ethical framework that can be used to arrive at a solution. This means that developing ethical norms and plans of action based on Buddhist practices

will pave the way for solving environmental problems and also helps to fulfill the purpose of Buddhism i.e removing pain from all sentient beings.

Moreover, understanding the workings of these two concepts will work as a driving force for wanting to keep the Buddhist precepts. The Dependent Origination says that everything is joined together in an interdependent relationship. It is characterized by its fundamental interdependence and interconnectedness of all phenomena [4].

Thus, there is no separation between individual human beings or between human beings and the rest of nature. Buddhism, asserts that all living things including animals and plants deserve respect since they possess the state of Buddhahood.

The second concept is the wisdom of the middle way. Akira Hirakawa [5] has quoted “the metaphor of a koto” propounded by Shakyamuni, to describe in an easily comprehensible manner the principle of the wisdom of the middle way as “the middle way of pleasure-and pain.” The concept of the middle way of pleasure-and-pain denies a deterministic stand towards either hedonism or austerity. That is, while accepting the value of both principles, the middle way demands harmony between the two and does not accept an inclination to either side.

Precepts help in regulating the human behaviour. There are the ten major precepts and the forty eight light precepts of the Brahma-net Sutra, regulate the behavior of human beings. But, the precepts in Buddhism are not absolute in the sense that some precepts attached with conditions like “without reason,” or “intentionally”. If one aims to achieve a particular end does not necessarily justify the means. Thereof, reasons for human actions which are contrary to Buddhist wisdom are prohibited. The human actions which threaten the relations in an ecosystem is considered as offensive as it works against the concept of dependent origination i.e disrupting ecological relations thereby undermines our own survival. Therefore, the present paper use the two doctrines as guiding concepts for guiding the ethical discourse in the context of GM crops in India.

GM Brinjal : Human Health and Environment

GM brinjal is primarily an agronomic traits aimed to control the Fruit and Shoot Borer (FSB) pest thereby reduces the number of pesticide applications, which in turn reduces the farmers expenditure on pesticides. Although, the benefits vary depending on the crop and pest pressure. When pest pressures are low, farmers may not be able to make up for the increased cost of the genetically engineered seed by increased yields. Reduction in direct exposure to insecticides

would lead to lesser health problems. Undoubtedly, it would offer invaluable environmental and health benefits to farmers, as reported by some studies [6,7].

Though transgenic crops at first glance appear beneficial to human beings as they have built-in protection against biotic and abiotic stresses. However, there are potential threats with GM crops to human health and environment as transgenic crops introduce extraneous genes into the ecosystem. Some of the concerns raised in the context of GM brinjal in India are appended below:

Scientific Evidence: No consensus on Safety of Bt brinjal

In case GM Brinjal in India, national and international experts have highlighted several flaws and questioned the scope and adequacy of the scientific risk assessment in evaluation of environmental and health risks. Some of the important concerns raised by the experts are: Gene flow to wild relatives resulting threat to brinjal diversity, chronic toxicity, sustainability, Lack of labeling and independent regulatory system, not following the international standards in biosafety. Out of the 18 scientists from abroad, who made submissions to the Ministry of Environment and Forests (MOEF), Government of India, only eight supported GM brinjal. In case of India, out of 26 submissions, 16 supported GM brinjal and 10 opposed [8]. They were divided on the adequacy of tests conducted for the safety of the GM brinjal.

Lack of independent testing mechanism

In the case of Bt brinjal, the GEAC’s recommendation was based on the biosafety tests conducted solely on the basis of data from field trials conducted by Mahyco, the promoter of the GM brinjal. According to Purkayastha *et al.*, [9] the lack of capacity to perform independent testing will have larger implications on the human health and the environment. The analysis of the scientific evidence clearly shows that there is debate among the scientists on the nature and number of tests that need to be carried out in establishing human and environmental safety. Therefore, keeping in view the importance of brinjal which is an almost daily consumption for majority of in India, the government should set up a testing mechanism of its own.

Isolation Distance and Growing Refugia

Several questions have been raised in the consultations on the feasibility of growing refugia and maintaining isolation distance in India given the majority of the Indian farmers have small and marginal land holdings.

In this context, Jayaraman [10] argues that How is it possible for Indian farmers grow and able to

set aside land for refuges (20% of the area), where the majority of them have less than 5 acres of land? Similarly, under Indian agricultural conditions, how will the government ensure that the minimum prescribed isolation distance of 300 metres between Bt Brinjal and other old native varieties? The following are the possible threats with contamination with gene flow:

Potential gene flow to wild relatives

The other important concern that has been raised with regard to the environment and biodiversity is the gene flow to wild relatives with transgenic crops. Horizontal gene transfer is defined as the non-sexual transfer of genetic information between organisms. The Ordinarily gene transfer takes place vertically from parent to offspring. Many fear that extensive adoption of *Bt* brinjal might threaten the genetic diversity of wild and cultivated forms of brinjal. It has been reported that the extent of natural crossing is 0 to 48% in brinjal depending upon insect activity [11].

Threat to Biodiversity of Brinjal

As per the data provided by National Bureau of Plant Genetic Resources of the ICAR reveals that there are 3951 collections in the Bureau and the number of diversity rich districts is 134. The Bureau also points out that diversity-rich regions are likely to be affected by the introduction of GM brinjal due to gene flow. The loss of diversity argument cannot be glossed over, especially when seen in light of the experience we have had in cotton where Bt-cotton seed has overtaken non-Bt seeds [12]. The Cartagena Protocol calls for extreme caution in introducing GM crops to countries which are the centres' of origin for the non-GM varieties of those crops [13].

Impact on Organic farmers

Lack of co-existence measure would severely affect the prospects of the organic farmers. In most developing countries where landholdings are much smaller and distances between farms are much shorter. With the contamination of their organic crops, farmers would lose the organic certification status for those crops and the premium prices they command.

Impact on Medicinal Plants

Brinjal provides food, some essential nutrients and has important medicinal values. The raw plant is also widely used in traditional medicine such as Ayurveda and Siddha traditions of Indian medicine. Concerns have been raised about the potential impacts of Bt brinjal on Indian system of medicine with the gene flow [2]. The Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH) is of the view that the chemical profile and bioactivity of genetically modified medicinal plants should be compared with the conventionally produced/cultivated medicinal plants to know the

alteration in the medicinal values of these plants before giving approval (Parliamentary standing Committee on Agriculture 2012, Para: 6.149,6.150, 8.59, and 8.61; Pp:228-229 and 331-332)

Monoculture and Soil Contamination with GM crops

By drawing the analogy from the Bt cotton experience, the interest groups have raised several concerns about the potential impacts of GM crops on the soil. The GM technology by its very nature promotes monoculture and has serious implications for soil erosion.

No labeling and Post Market Surveillance Mechanism

At present there is no labelling and post market surveillance mechanism in place in India. Once GM is released there may be no turning back. Is it right giving priority of agronomic performance (yield) of a crop over the environmental impacts it carries? With regard to post market surveillance, Amanor-Boadu [14] argues that post-market surveillance system would assist policy-makers to capture information about both benefits as well as long term adverse effects on human health and the environment.

Regulatory Failures : Illegal Bt cotton

Bt cotton was officially commercialised in India in March 2002, although unapproved Bt varieties are known to have been grown in the state of Gujarat and parts of Maharashtra, Madhya Pradesh, Andhra Pradesh and Karnataka for an uncertain period of several years prior to that date [15]. Navbharat-151 was one of the earliest brands of illegal Bt-cotton was being sold in India before it was approved for commercial cultivation which showcased the regulatory incapability in India. This highlighted the difficulty of monitoring the flow of transgenic materials in a developing country [16,13].

Can GM crops Enhance Food Security?

Food Security is characterized as “ a situation when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” [17]. The status of food security of a country needs to be assessed at three levels. First is the availability of food at the national level on a sustainable basis. Second is the physical and economic access of all households to food and the third is the utilization of available food by individuals, which depends on intra-family allocation of food. Social factors like education, primary health care, gender bias, and role of women in household decisions affect food security at the individual level. The role of genetically

modified (GM) crops for food security is one of the important aspects of public controversy.

Is technology there in the seed?

First of all, the Bt toxin is an insecticide, and insecticides cannot increase yields, only protects yield losses against particular infestation/pest. The advantage of the protection of the yield will come only if there is an infestation. If in a particular year there is no infestation, the farmer who has used GM seed will not get any advantage because there are no harmful effects. With regard to food security, the opponents have argued that increasing access, better storage and distribution would help to address food security than GM crops.

Between 1997 and 2007, 1.83 lakh tonnes of wheat, 6.33 lakh tonnes of rice, 2.20 lakh tonnes of paddy and 111 lakh tonnes of maize were damaged in different FCI godowns. The finding shows that as of Jan 1 2010, 10,688 lakh tonnes of food grains were found damaged in FCI depots, enough to feed over six lakh people for over 10 years- revealed a right to information petition [18]. The Secretary, Department of Agriculture and Cooperation confessed before the Parliamentary committee and stated that a saving of 10% in post-harvest crop losses would mean 23 million tonnes of extra food grains. In this context the Committee opined that the problem today is that there is a huge disparity in availability of food in spite of sufficient production and more than double the amount of buffer norms food stocks with the Government. A large majority does not have access to food due to extreme poverty while colossal amounts of food grains, fruits and vegetables are being lost during post-harvest storage. (Parliamentary standing Committee on Agriculture 2012, Para 7.71: 276). The Parliamentary committee also questioned the rationale for commercialization of GM cotton in India, which is not a food crop.

The International Assessment of Agricultural Knowledge, Science and Technology for Development [19] report based on 4 years of investigation by more than 400 scientists from over 60 nations (a unique collaboration of the World Bank, FAO, UNDP, UNEP, WHO and representatives of governments, civil society, private sector and scientific institutions) indicate that GM crops are highly controversial and will not play a substantial role in addressing the challenges of climate change, loss of biodiversity, hunger and poverty. Instead, small-scale farmers and agro-ecological methods are the way forward; with indigenous and local knowledge playing as important a role as formal science. India is also a signatory to this report.

Therefore, Haribabu [20] argues that genetic engineering technology is supply-driven rather than demand-driven. Because the corporate sector, especially the multinational enterprises have developed Bt cotton

inserting Cry1 AC gene, and now they are trying to market it aggressively with the GM brinjal and other food and non-food crops in India.

Insights from Buddhist Doctrines

On the one hand, we have experimented with green revolution to supply enough food. The Green Revolution helped India to move from the status of net importer to one with self-sufficient food security through domestic production. But, as Vandana Shiva [21] argues that the Green Revolution has actually deepened the gap between the rich and the poor, made small holders lose their self-sufficiency, increased agrarian inequality and destroyed the eco-system. According to Pretty [22], the high external input (chemical and fertilizer) intensive green revolution agriculture has contributed to the long term environmental costs, fossil fuel consumption, and greenhouse gas emissions. On the other hand using agricultural chemicals for killing pests is considered as evil from the viewpoint of *dependent origination*. In Buddhism, all living things are respect worthy because they are endowed with Buddha Nature. However, when the value of human life is compared with that of other living things, human beings are given priority. Therefore, as a matter of course, priority should be given to supplying food to human beings, and people suffering from starvation. However, it goes without saying that if we can develop a way to supply enough food without using agricultural chemicals, such methods should be used. Transgenic crops may appear to meet such expectations. However, if the genetic code of an ecosystem is disturbed, such, transgenic crops would need to be reconsidered.

While arguing that genetic engineering is not the answer to hunger, Sharma [23] concludes in his pamphlet on GM crops by writing "*Like the Green Revolution, which bypassed the small and marginal farmers, the misplaced gene revolution will bypass the hungry*".

Here we need to make full use of the wisdom of the *middle way*. Keeping in mind that one technology is not the solution for all the agro-climatic zones, we need to adopt plurality of technologies based on the their relevance to suit to the different agro-climatic zones.

Need for Plurality of Strategies

Several propositions were made by the interests groups with regard to the need for a plurality of practices/approaches based on the local specific problems in different agro-climatic zones in India. The opponents of the technology have also argued that pest needs to be managed with the sustainable, cost effective, alternative approaches like NPM or Organic methods rather than killing the pest with Bt gene. For

instance, Bt cotton is grown in three agro-climatic zones and nearly 60% of cotton is grown under the rain fed conditions in the central zone. Similarly, Brinjal is grown in eight different agro climatic zones in India. Therefore, there is an imperative for thorough needs assessment of the ecological and socioeconomic situation into which the technology is introduced.

Relevance of the GM Technology : Abiotic stresses

Various concerns have been raised with regard to the relevance of GM crops with biotic traits when the Indian farmers are grappling with from a biotic stresses such as drought and salinity. The National Commission on Farmers [24] pointed out that priority must be given in genetic modification to the incorporation of genes that can help impart resistance to drought, salinity and other stresses.

Such prioritisation of the technology is possible only if public research institutions take the lead in developing suitable GM crops. While GM is certainly not the only answer to these questions, it is possible to grow more drought-resistant or salinity-tolerant crops, or use less pesticide [9].

Need for precautionary and participatory approaches

The Parliamentary Standing Committee on Agriculture on agriculture identified various flaws and shortcomings in the functioning of the regulatory mechanism meant for the purpose recommended that : till all the concerns voiced in their Report are fully addressed and decisive action is taken by the Government with utmost promptitude, to put in place all regulatory, monitoring, oversight, surveillance and other structures, further research and development on transgenics in agricultural crops should only be done in strict containment and field trials under any garb should be discontinued forthwith. (Parliamentary Standing Committee on Agriculture [25] Para Nos.8.116, 8.121 and 8.125, Pp:370, 375 and 377). Further, the decision making on Bt brinjal has implications for other GM crops which are under regulatory pipeline. At present there are many food/ non-food GM crops under the regulatory pipeline at various stages. According to one estimate, of the 91 applications for field trials before the GEAC, 44 are GM food crops (GAIN IN 3083). Therefore, the decision making on GM crops would be based on it Precautionary Principle (see End note) and participatory approaches to uphold the principles of democracy.

CONCLUSION

The instruments of India's food policy in the late 60s have laid foundation for modernization of its agriculture and provided the needed incentive framework for the rapid growth of the two major cereals viz., wheat and rice contributing to near food security at

the aggregate level. However, these achievements are the cost of other grains and also widened the inequalities between irrigated and rain fed regions as well among the farm size classes. Further, various political, economic, social, health and environmental concerns have been raised in the context of GM Cotton experience. Given the current pace of environmental degradation and climate changes, the important question is to evaluate whether genetic engineering is the only alternative to increase productivity and remove hunger? The increase in productivity may not necessarily remove hunger as the question of hunger is related to distributive justice and accessibility to food. Food surpluses and hunger can co-exist as one finds in India. If agriculture grows at over 4 per cent and is inclusive, then the food insecurity of the tiny farmers of agriculture in the rain fed areas would reduce considerably. Given the great public policy ramifications of the GM crops on the human health, environment, economic, social, cultural and moral spheres, the comprehensive ethical assessment is important to construct policies that are based on an understanding of ecosystem management. The policy making pertaining to Indian agriculture should not be driven by technocratic ideology and incorporate the principles of plurality, Relevance, precaution and participation, guided by the two Buddhist doctrines –the dependent origination and middle way.

Notes:

1.The most widely cited formulation of the Precautionary Principle is from the Rio Declaration on Environment and Development, Principle 15: *'In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation'* (Rio Declaration on Environment and Development 1992).

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