

**AT THE CROSSROADS: LEGAL PROTECTION OF ‘TRANSGENIC
VARIETIES’, ‘FARMER’S RIGHTS’ AND ‘PLANT GENETIC
DIVERSITY’**

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ABSTRACT

The advancement in the agro-biotechnological sector has led to the introduction of genetic farming techniques such as use of genetically modified [GM] seeds and developing transgenic varieties. The traditional farmers who practise indigenous and age-old techniques of agriculture play a major role in the sustainable development process by ensuring that the demands of the present generation are met without compromising the needs of the future. With the agro-biotech companies developing newer varieties and seeds by genetic modification, the crop production and crop resistance have considerably improved. However, such genetic farming methods and techniques are posing greater challenges to the environment as well as the livelihood of farmers. On the one hand, these inventions may lead to loss of genetic biodiversity and causing the issues of genetic pollution, gene drift, monoculture, emergence of super weeds etc. On the other hand, the legal protection given to these GM varieties poses serious threats to the conventional farming techniques as well as livelihood of farmers.

The legal protection of transgenic varieties and seeds are covered under the intellectual property [IP] regime where the TRIPS Agreement gives it an open discretion to the member nations to provide Patent Protection or sui-generis protection to plant varieties. This flexibility has given rise to doubts as to the type of IP protection to be provided to such varieties. Although India has adopted a sui-generis model of protection under the Protection of Plant Varieties and Farmer Rights Act, the possibility of patent protection to ‘all kinds of technology’ including the ‘agro-biotech inventions’ is leading the debate on legal protection

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of transgenic varieties. Therefore, this paper attempts to highlight the legal provisions involved in the Patent Act as well as the sui-generis law to understand the overlap and discusses the ongoing legal battle on patented GM technologies. This paper also attempts to highlight the impact of IP protected varieties on farmers' life and environment and suggests the best possible protection that could be provided to these transgenic varieties and other measures under the present Indian IP law regime.

INTRODUCTION

Farmers in an agrarian economy like India cultivate crops throughout the year and are responsible for food production and sustaining food security for the entire nation. Farming being a traditional occupation continues to be the major industry in such a country's economy. However, in a scenario due to population explosion, plant pests and diseases, soil erosion, soil infertility, poor land planning, rapid globalization, industrialization and urbanization, the issues of food scarcity and reduction in food production for masses is a matter of concern¹. Further, change in climate patterns due to emission of toxic substances from industries like carbon monoxide, carbon dioxide, methane, nitrous oxides and chlorofluorocarbons consequently increases the earth's atmospheric temperature leading to global warming and el-Nino effects. The *United Nation Framework Convention on Climate change, 1992*² aims at stabilizing the greenhouse concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Global warming triggers change in climate, leading to drought, famine, flood and untimely rainfall which directly affect the timely cultivation of crops by farmers. Thus, there emerges a need to find new scientific solutions for crop production and issue of food paucity. This has resulted in a new phase of agro-biotechnological inventions to produce genetically modified [GM] seeds and crops. The transnational companies such as Monsanto, DuPont, etc., have developed technologies having Intellectual Property [IP] Protection to genetically modify a seed for increasing the yield and resistance against such adverse conditions. The farmers in agro-based economies, who use traditional seeds and techniques of agriculture, lack financial and technical assistance to produce similar results using GM seeds. This rapid expansion of

¹ Pingali, Prabhu L. "Green revolution: Impacts, limits, and the path ahead." Proc Natl Acad USA vol. 109, 31 (2012).

²The United Nation Framework Convention on Climate Change, 1991, available at, <https://unfccc.int/resource/docs/convkp/conveng.pdf> (Visited on 25-06-2020).

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agro-biotechnological industries is further causing unprecedented loss to the plant genetic diversity.

Farmers play a major role in the ‘sustainable development process’³ which ensures that the demands of the present generation are met without compromising the needs of the future generation’ by saving seeds and transferring their traditional knowledge. Attaining Food security by reducing hunger and inaccessibility to food is one of the main agenda of sustainable development⁴. In India, the farming community is the largest seed producer and a shift towards genetically engineered farming would displace the traditional farmers from being the largest seed producers⁵. Hence, farmer-centric approach is the key to attain sustainability in food production. The acute shortage of food and enhanced hunger rate as per the Global Hunger Index [GHI] have forced farmers across the world to reconsider their farming techniques and deploy science and technology to it. India was ranked in 97th position amongst 117 countries in 2016 GHI⁶, remarked ‘serious’ and is now pushed to 102nd position in 2019⁷, once again being remarked as ‘serious’.

In contrast to the traditional farming methods practised in India, the Green revolution⁸ introduced agronomic technology in wheat production to obtain high yield. These varieties which require low irrigation were found to be resistant to pests, insects and weeds. This movement was a blessing in menace as on one hand it helped in meeting food scarcity crisis, ensuring farmers livelihood but on the other hand, has adverse environmental impacts. The transition from the traditional farming methods to revolutionary farming methods including GM farming is further causing livelihood challenges to farmers, which is discussed infra. The indigenous knowledge on farming is put to threat due to intellectual property protection

³ David A. Cleveland, Daniela Soleri and Steven E. Smith, “Do Folk Crop Varieties Have a Role in Sustainable Agriculture?”, *BioScience*, Vol. 44, No. 11, pp.740-751, (1994).

⁴ Sustainable Development in the 21st Century, “Food and Agriculture: The future of Sustainability”, available at, https://sustainabledevelopment.un.org/content/documents/agriculture_and_food_the_future_of_sustainability_web.pdf (Visited on 25-06-2020).

⁵ Vandana Shiva, “Biodiversity Totalitarianism: IPRs as Seed Monopolies”, *Economic and Political Weekly*, Vol. 32, No. 41, pp. 2582-2585, (1997).

⁶ Global Hunger Index Report 2016, available at, <http://ghi.ifpri.org/> (Visited on 25-06-2020).

⁷ Global Hunger Index Report 2019, available at, <https://www.globalhungerindex.org/india.html> (Visited on 25-06-2020).

⁸ Malathi Lakshmikumaran, “Genetically Modified Plants: The IP and Regulatory Concerns in India”, In: Liu KC., Racherla U. (eds) *Innovation, Economic Development, and Intellectual Property in India and China*, ARCIALA Series on Intellectual Assets and Law in Asia. Springer, Singapore, (2019).

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granted to GM technologies and other agricultural biotechnological inventions in the form of patents or plant varieties protection⁹.

IP PROTECTION TO GM SEEDS AND TRANSGENIC VARIETIES

The first generation agricultural biotechnology introduced herbicide tolerant and pest tolerant traits into few main crops- cotton, soya-beans, corn, canola which caused the crops to produce a natural occurrence of a chemical called 'Bacillus Thuringiensis'(Bt) that is toxic to agricultural pests but does not harm humans and environment¹⁰. The transgenic plants and crops developed from such genetically modified seeds help in increasing yield by providing an inbuilt mechanism to fight against the pests. Moreover, the benefits of genetic modification of seeds is not just limited to controlling pests, but also provides crops with increased shelf-life¹¹ increased nutritional benefits, resistance against climate change, soil salinity, etc...¹² However, the benefits of GM technology is often overshadowed by its consequences on the environment and consumers leading to discussion on IP protection to such GM technologies and its related inventions.

(A) TRIPS and Conventions on Biodiversity

The TRIPS Agreement¹³ under the WTO Agreements deals exclusively with the protection of intellectual property. The agreement provides for minimum standards of IP protection of inventions pertaining to 'all fields of technology' on fulfilment of the prerequisites of grant such as novelty, inventive step and industrial applicability¹⁴. This gives the scope for patenting agricultural and biotechnological inventions. With regards to Inventions concerning

⁹ Usha Menon, "Intellectual Property Rights and Agricultural Development", Economic and Political Weekly, Vol. 26, No. 27/28 (1991).

¹⁰ Geoffrey Barrows, Steven Sexton and David Zilberman, "Agricultural Biotechnology: The Promise and Prospects of Genetically Modified Crops", The Journal of Economic Perspectives, Vol. 28, No. 1, pp. 99-119 (Winter 2014).

¹¹ Bruening, G. & Lyons, J.M., "The case of the FLAVR SAVR tomato", California Agriculture 54 (2000). available at, https://www.researchgate.net/publication/269845391_The_case_of_the_FLAVR_SAVR_tomato

¹² S. Jhansi Rani, R. Usha, "Transgenic plants: Types, benefits, public concerns and future", Journal of Pharmacy Research Vol.6 879-883 (2013).

¹³ TRIPS Agreement, available at, https://www.wto.org/english/docs_e/legal_e/27-trips.pdf, (Visited on 03-07-2020)

¹⁴ Art 27.1 of the TRIPS Agreement.

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propagation of plants, it provides that member countries can protect either under the patent system or by an effective sui-generis system or by the combination of both¹⁵.

The plant genetic resources form part of the 'common heritage' of mankind, hence no one can be granted exclusive rights or protection on breeding or propagation of plants¹⁶. The sustainable and equitable development of natural resources is advocated in *Stockholm Conference*¹⁷ and the *Brundtland Commission's Report*.¹⁸ The *Convention on Biological Diversity*¹⁹, in its preamble has recognized the importance of traditional men and women in the conservation and preservation of biodiversity. Sustainable use of the biological and genetic resources and fair and equitable sharing of benefits arising from the genetic resources are the objectives of this convention. The *Cartagena Protocol on Bio-safety, 2000*²⁰ is a supplement to the *Convention on Biological Diversity* and its main objective is to ensure an adequate level of protection in the field of safe transfer, handling and use of "living modified organisms resulting from modern biotechnology²¹ which may have adverse effect on the conservation and sustainable use of biological diversity". The *Nagoya Protocol, 2010*²² also addresses issues relating to access and benefit-sharing of genetic resources. Article 9 provides that the benefits arising from the utilization of genetic resources shall be directed towards the conservation of biological diversity and the sustainable use of its components. It also gives importance for saving traditional knowledge on utilizing genetic resources.

The knowledge and rights of the rural farmer community has to be protected and strengthened to conserve the biodiversity. The concept of farmer right had its origin in the

¹⁵ Art 27.3(b) of the TRIPS Agreement.

¹⁶ Section 3(h) and Section 3(j) of the Patent Act, 1970.

¹⁷ The first International Conference on Human Environment held in Stockholm between 5-16 June, 1972.

¹⁸ The World Commission on Environment and Development, 1983

¹⁹ Adopted in 1992, at Rio-de-Janerio on 5th June, 1992 at the United Nations Conference on Environment and Development ("The Rio Earth Summit"), available at, <https://www.cbd.int/>, (Visited on 05-07-2020).

²⁰The Cartagena Protocol, available at, <https://www.cbd.int/doc/legal/cartagena-protocol-en.pdf>, (Visited on 05-07-2020).

²¹ *Modern biotechnology means "the application of in vitro nucleic acid techniques or fusion of cells beyond the taxonomic family that overcome natural physiological, reproductive or recombinant barriers and are not techniques used in traditional breeding and selection"*.

²²The Nagoya Protocol, available at, <https://www.cbd.int/abs/doc/protocol/nagoya-protocol-en.pdf>, (Visited on 05-07-2020).

*FAO International Undertaking on Plant Genetic Resources*²³. Farmers using their traditional knowledge cultivate a variety of crops without laboratory research and they are given the right for identifying, conserving and developing the traditional variety at par with the genetically modified varieties. The *International Treaty on Plant Genetic Resources for Food and Agriculture*²⁴ also gives broad guidelines to the member states²⁵ regarding the protection of traditional knowledge, benefit sharing and right of farmers to participate in the management of plant genetic resources. The treaty also reflects the objectives of biodiversity convention and it is the first exclusive agreement dealing with management of crop genetic resources. The *International Union for the Protection of New Varieties of Plants* (UPOV) is a sui-generis system which protects new plant varieties and allows the breeders community to freely use the protected varieties as a plant genetic resource for further breeding²⁶. The international system of protection of plant varieties aims in conserving biodiversity and also protecting farmers' traditional knowledge to attain the goal of sustainable development. The interface between the TRIPS Agreement and Conventions on biodiversity is established under Art. 27(2) and Art. 27 (3) (b) of the TRIPS Agreement which provides that patentability of inventions affecting human life, public morality and environment shall be excluded.

(B) Legal protection of GM Seeds and Varieties in India in the light of Monsanto-Nuziveedu battle.

The patentability of biotechnological inventions concerning genetic modification of seeds and propagation of plant variety is subject to fulfilling the granting criteria. In the context of patenting GM seeds, it is understood that the genetic modification of seed involves human intervention and is not an essentially biological process. In India, as per Section 3(j) of the Patent Act, '*plants in whole or any parts thereof including seeds, varieties and species and essentially biological processes for production or propagation of plants*' are not patentable. Thus the plant and 'plant varieties' in general are not patentable. In fact, even the parts of the

²³ The FAO International Undertaking on Plant Genetic Resources, 25th Session of the FAO Conference-Rome 1989, Resolution 5/89, available at, <http://www.fao.org/3/x5588E/x5588e06.htm#Resolution5>, (Visited on 06-07-2020).

²⁴ The International Treaty on Plant Genetic Resources for Food and Agriculture, available at, <http://www.fao.org/3/a-i0510e.pdf>, (Visited on 06-07-2020).

²⁵ India also ratified in 2001.

²⁶ Bonwoo Koo, Carol Nottenburg and Philip G. Pardey, "Plants and Intellectual Property: An International Appraisal", Science, New Series, Vol. 306, No. 5700, pp. 1295-1297, (2004).

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plant like seeds, cells, tissues, cell line etc that propagate naturally, are also excluded from the patentable subject matter. However, modification in the gene sequence of the plant seeds by using modern biotechnology is not seen as merely a change in the seed but is considered as an alteration in the chemical composition of that particular DNA. The question arises if such a changed and new composition of the nucleic acid or DNA, (the genetic modification) will qualify as plant part or non-naturally occurring chemical composition. This was discussed in the light of Section 3(j) and 3(h) of the Patent Act in *Emergent Genetics India Pvt., Ltd. v. Shailendra Shivam*²⁷, where the Hon'ble Delhi High court ruled that plants and seeds that contained the modified DNA sequences cannot be given patent protection. Moreover, in addition to the tests of novelty, inventive step and industrial utility, the DNA sequence that is introduced to change the chemical composition of the seed is also bound to pass the 'test of efficacy' and must not be a mere incremental addition as per Section 3(d)²⁸.

India has adopted the Protection of Plant Variety and Farmers Right Act, 2001 (PPVFR Act), *sui generis* model as an alternative to the patent system for plant protection. The main objective is to provide for the establishment of an effective system for protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants²⁹. The protection of plant varieties/transgenic varieties is covered under the Protection of Plant Variety and Farmers Right Act, 2001. Section 2 (za) of the Act, which defines 'Variety' includes 'transgenic variety' and the protection of such variety is subject to novelty, uniformity, stability and distinctiveness on the phenotype characteristics. It is also pertinent to note that certain varieties are excluded from Plant variety protection under Section 29, such as in cases where prevention of commercial exploitation of such variety is necessary to protect public order or public morality or human, animal and plant life and health or to avoid serious prejudice to the environment; where the variety involves any technology including the genetic use restriction technology [GURT] and terminator technology which is injurious to the life or health of human beings, animals or plants. Further, Section 92 of the Act provides that the Act shall have an overriding effect on all the

²⁷ 2011(47) PTC 494 Del.

²⁸ IPAB Decision dated July 05, 2013 in the matter 2 407/DELNP/2006.

²⁹ Suman Sahai, "Government Legislation on Plant Breeders' Rights", *Economic and Political Weekly*, Vol. 29, No. 26, pp. 1573-1574, (1994).

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other Acts which are in force. This section is thus the key to the interpretation of applicability of the Plant Varieties Act for the protection of GM seeds and varieties.

In the Single Judge *Monsanto v. Nuziveedu* case³⁰, the meaning of ‘transgenic variety’³¹ in the context of price control of Bt Cotton seeds was explained to mean “*seed or planting material synthesized or developed by modifying or altering the genetic composition by means of genetic engineering*”. The case also discussed the patentability of genetically modified Bt Cotton seeds by the Monsanto group while considering the injunction applications and regulation of trait value or license fee for the said GM seeds against receiving seed companies such as Nuziveedu, etc. While the Single Judge held that the patentability of Bt cotton by Monsanto was a subject matter of trial, not conclusive of the patent validity however ensured that the trait value be paid by the receiving seed companies as per the rates fixed by the Government. The case was appealed by both the parties before the Division bench³² on the grounds of trait fee regulation and the validity of injunction imposed. The Hon’ble Judges, while deciding on the grant of injunction, held that GM seeds and varieties are non-patentable under the Patent Act and instead, the registration was to be made under the Plant Varieties Act by Monsanto. Aggrieved by this decision, Monsanto preferred a Special Leave Petition³³ before the Hon’ble Supreme Court of India. The Hon’ble Court held that the Division bench was bound to decide on the validity of the injunction granted, rather than the patent validity. Thus, the case was remanded back to the Single Bench which is pending trial.

The forthcoming legal battle between the companies such as Monsanto and Nuziveedu, is crucial to determine the patent validity of GM seeds and varieties under the Patent Act, the extension of protection under the Plant Varieties Act, the protection of farmer’s rights in saving, swapping and sharing seeds for further cultivation, benefit sharing and also the conflict in safeguarding breeder’s rights such as licensing rights. The PPVFR Act also aims to balance the rights of farmers with that of the breeders and researchers such as Monsanto Co. In order to protect the farmers, ‘Gene fund’ has been constituted by the Government of India, where the breeders deposit funds for benefit sharing. A ‘Plant Genome Saviour Farmer

³⁰ *Monsanto Technology LLC and Ors. v. Nuziveedu Seeds Ltd. And Ors.*, CS (COMM) 132/2016 - IA No.2406/2016 (O.39 R. 1 & 2 CPC), IA No.9070/2016 (O.39 R. 2A CPC), IA No.4277/2016 (O. 39 R. 4 CPC)

³¹ Clause 2 (t) in the Cotton Seeds Price (Control) Order, 2015.

³² *Nuziveedu Seeds Ltd. And Ors. v. Monsanto Technology LLC and Ors.*, 2018 (74) PTC 12 (Del).

³³ *Monsanto Technology LLC and Ors. v. Nuziveedu Seeds Ltd. And Ors.*, AIR 2019 SC 559

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Reward³⁴ is also constituted as compensation from the gene fund to farmers who are engaged in the selection, preservation and conservation of genetic resources of land acres and wild relatives of economic plants.

IMPACT OF GM VARIETIES ON FARMER'S LIVELIHOOD AND BIODIVERSITY

Multinational companies like Monsanto corporation and Du-Pont are now investing huge sum of money in developing genetically modified (GM) crops and have come up with Bt cotton, Bt Brinjal, GM mustard and Bt Brassica(cabbage) etc...The plight of farmers is worsened by recognizing and granting plant variety protection or patent protection under some legal systems. In general practice, farmers keep a share of the crop grown as seeds for the next season. The farmers cannot preserve seeds anymore as it would amount to intellectual property theft³⁵ due to protection extended to biotech companies. Giant MNCs have now developed inbuilt seed terminator technology³⁶ which produces sterile seeds, thus curbing the chance of further use and propagation of seeds by farmers. This creates a livelihood challenge to the farmers who 'save, swap and share' seeds that have been transmitted to them over generations but will have no choice but to buy new seeds every year from such MNCs at huge costs³⁷. Even the farmers who did not cultivate the GM crop could be made liable for IP infringement, if their crops show the characteristics of GM crops due to gene flow, which could be induced due to unstoppable cross pollination led by natural pollinating agents. The *Canola Case* study³⁸ is a glaring example where the farmer was made to pay huge costs to the biotech company Monsanto as damages for innocent infringement. Further, the agricultural land are now indirectly being converted by the MNCs for conducting field research with GM seeds, causing genetic pollution and is one of the latest challenges to the livelihood of farmers. Bio piracy³⁹ is yet another problem faced by farmers, since their traditional knowledge on certain varieties of crops, resistant to disease and climate change, is

³⁴ Rule 2 of Protection of Plant Varieties and Farmers Rights (Recognition and Reward from the Gene Fund) Rules, 2012.

³⁵ *Vernon Hugh Bowman v. Monsanto Company, et al.*, 185 L. Ed. 2d 931. The defense of 'doctrine of exhaustion' was not recognized and farmers made to pay damages.

³⁶ Elizabeth Verkey, *Intellectual Property Law and Practice* (pp-573), Eastern Book Company Publishing (P) Ltd., First Edition,

³⁷ N. Lalitha, "Intellectual Property Protection for Plant Varieties: Issues in Focus", *Economic and Political Weekly*, Vol. 39, No. 19, pp. 1921-1927, (2004).

³⁸ *Monsanto Canada Inc. v Schmeiser*, [2004] 1 S.C.R. 902, 2004 SCC 34

³⁹ David A. Cleveland and Daniela Soleri, "Rethinking the Risk Management Process for Genetically Engineered Crop Varieties in Small-scale, Traditionally Based Agriculture", *Ecology and Society*, Vol. 10, No. 1, (2005).

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being stolen by giant MNCs who consequently obtain patent or trade secret protection. In the highlands of Mexico, Researchers of MegaAgriCorp, identified varieties of plants and obtained information from the local farmers on cross breeding techniques and used it for developing smut resistant strains of corn⁴⁰. In India, the dispute amongst Monsanto, Nuziveedu and other seed companies is a glaring example of undue difficulties to farming caused due to high trait values on patenting and licensing of the branded seeds. This has led to the passing of Price control legislations for Bt cotton seeds and regulation of licensing terms fixed by such companies to prevent exploitation of farmers who use seeds from them.

The adoption of gene breeding techniques and farming using GM seeds has an adverse impact not only on farmers' livelihood but also on the soil and environment, as well as posing serious threats to ecology and biodiversity. When the GM crops are cultivated, the bacteria which have insecticidal properties percolate into the soil and decrease the fertility and biota of the soil destroying insects and earthworms beneath it. It also affects the beneficial species like the endangerment of *Monarch Butterflies*⁴¹ as these species lay eggs on *Milkweed* which is destroyed by the GM crop (Bt corn) and this has led to anti-GMO movements in the US. Developing crops using gene-technology makes the environment vulnerable to new kinds of problems such as genetic pollution, genetic contamination and gene-breeding through cross pollination, genetic uniformity and depletion of genetic diversity. The use of GM technology compels the use of one variety, leading to monoculture⁴² ultimately causing genetic uniformity. It further leads to depletion of genetic variety, as it promotes the cultivation of one particular set or variety of crops, discarding the cultivation of wild variety which gives genetic diversity. In fact, according to the United Nations Food and Agriculture Organization⁴³, 75% of the world's food crop diversity was lost in the twentieth century as farmers abandoned local varieties in favour of genetically uniform high-yielding crops. Wild relatives of crops, which are not cultivated, are increasingly at risk of extinction as a consequence of the loss, degradation and fragmentation of natural habitats due to continuing

⁴⁰Paul J. Heald, "The Rhetoric of Bio piracy", 11 *Cardozo J. Int'l & Comp.L*, 520 - 521(2003).

⁴¹ Anthony M.Shelton and Mark K.Sears, "The monarch butterfly controversy: scientific interpretations of a phenomenon", *The Plant Journal* 27 (6) *GM Special Issue*, pp-483-488 (2001).

⁴² Vandana Shiva, "The Violence of Green Revolution Third World Agriculture Ecology and Politics", *Zed Books Ltd*. 2nd Impression (1993).

⁴³ U.N. FOOD & AGRIC. ORG., *First Fruits of Plant Gene Pact*, (June 21, 2009), *available at*, <http://www.fao.org/news/story/0/item/20162/icode/en/> (Visited on 07-07-2020).

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industrialization of agriculture and selective cultivation of high yield variety⁴⁴. In Ireland, during the 1840s, the '*Irish Lumper Potato*'⁴⁵ which had lesser genetic variation was lost due to selective breeding of that particular variety and other varieties of potato were also lost causing famine in the region. Genetic uniformity increases the risk of losing genetic plant varieties when environmental variables change. Thus, genetically modified crops increases the risk of genetic uniformity and also leads to depletion of genetic diversity.

The transgenic crops require external support of chemical fertilizers for their growth, increasing pH-content and further contaminates the soil. 'Genetic contamination' is caused by the gene-addition which will affect the inherent genetic makeup of the crops causing loss or dilution of the inherent character of such crops by cross-breeding with relative and neighbouring plants. It also paves way for formation of 'Super weeds', by natural process of cross pollination. These 'Super weeds' will be resistant to any kind of weedicides or chemical action and leads to mass destruction of the standing useful crops. 'Genetic pollution' is also causing collateral damage to other crops, species and natural resources. Genetic Drift happens when natural pollinating agents carry genetically-altered pollen into adjoining fields, polluting the genetic set up of the organic farms cultivated by non-GM farmers. An incident was reported in Texas where the organic farm⁴⁶ was contaminated by genetic drift from GM crops on nearby farms. GM pollen can travel for miles, enter organic farmland, and "cross-pollinate" organic crops. The resulting contamination renders those crops unfit for the organic market.⁴⁷ Gene-altered crops are inherently more unpredictable than chemical pollutants and they can reproduce, migrate, and mutate. It is virtually impossible to recall genetically engineered organisms back to the laboratory or the field once it is drifted away by natural processes. Bio-invasion⁴⁸ occur altering ecosystems and impedes sustainable development of plant genetic resources, where plants themselves become invasive of natural habitats.

⁴⁴Christian Nellemann et al. eds., "United Nations Environment Programme [UNEP], The Environmental Food Crisis: The Environment's Role In Averting Future Food Crises" (2009).

⁴⁵ Carmen G. Gonzalez, "Climate Change, Food Security, And Agro-biodiversity: Toward A Just, Resilient, And Sustainable Food System", 22 Fordham Envtl. L. Rev. 493 (2010-2011).

⁴⁶*Organic Seed Growers and Trade Association et al. (OSGATA) v. Monsanto*, 85 F. Supp. 2d.

⁴⁷ Paul J. Heald & James Charles Smith, "The Problem of Social Cost in a Genetically Modified Age", 58 Hastings L.J. (2006).

⁴⁸ Elizabeth Hodson De Jaramillo, 'Ecological Aspects of Biosafety', Chowdhury MKA, Hoque MI and Sonnino A (Eds.). Biosafety of Genetically Modified Organisms: Basic concepts, methods and issues, (2009).

CONCLUSION AND SUGGESTIONS

Transgenic plants and crops help in increasing yield and provide utmost resistance against adverse climatic conditions. However, the increased use of GM crops to attain food security amidst the problems of climate change has led to the compromise of sustainable development goals. Sustainable agricultural techniques are the need of the hour to face problems relating to climatic change issues, food security and safeguarding the interests of marginal and small farmers forming a greater force of rural labourers⁴⁹. Thus, retaining and practicing sustainable farming techniques is very crucial to ensure food availability and also to balance farmer's livelihood and ecological biodiversity. Moreover, Participatory and Co-operative farming can considerably reduce the risk of genetic contamination, genetic pollution and genetic drift. It also promotes self-reliant farming and encourages seed sharing and swapping to preserve genetic plant diversity. In order to use genetically modified seeds or crops, there must be an adequate impact assessment done by the Government authorities to identify the benefits and negative repercussions of its use on the environment and public health. Separate regions must be earmarked by the Government for organic farming and GM farming to avoid genetic drift and loss of genetic diversity.

The legal protection of "GM seeds and varieties" discussed in the light of *Monsanto-Nuziveedu* legal battle would be the turning point decision in the Indian patent and plant variety protection regime. The Patent Act as on date excludes the patentability of genetically modified seeds and varieties while the transgenic varieties are capable of being protected under the Plant Varieties Act. Both the Acts deny protection to any technology or variety which is in contradiction to the public health, morality and environment. The PPVFR Act has considerable provisions to safeguard the interests of traditional farmers and their indigenous varieties. However, the Act suffers from providing a practical solution to the ignorant farmers who do not have sufficient means to establish or prove their 'variety' fulfils the protection criterions. The rights of farmers under the Act are countervailing to the rights of breeders under the Act. Though farmers and breeders are treated on the same footing, the results for providing protection become ghastly discriminated against the standards of protection. The

⁴⁹ David A. Cleveland and Stephen C. Murray, "The World's Crop Genetic Resources and the Rights of Indigenous Farmers", *Current Anthropology*, Vol. 38, No. 4, pp. 477-516 (1997).

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breeders could prove the distinctiveness and uniformity of their varieties in an in-situ condition whereas the farmers do not produce uniform results, as the produce is much dependent on the uncontrollable, variable climatic and weather conditions. The implementation of the benefit sharing provisions under the Act is not effectively carried out as the farmers are generally unaware of the mode of access to benefit share. The benefit share under the Act can be claimed by making an application on publication of the concerned variety in the Plant Varieties Journal which is evidently impractical. While the PPVFRA provides for farmer's rights protection and benefit sharing, the enforcement mechanism of such provisions needs improvement. The representation of the farmers in the technical board constituted by PPVFRA needs to be strengthened to remedy the challenges faced by the farmers who approach for registration of variety, benefit sharing, etc. There needs to be adequate checks and balance measures to integrate protection of transgenic varieties, preserving biodiversity and seed regulation. The critical gaps need to be filled in such contradicting protection measures to ensure their effective implementation. The adverse impact of agro-biotechnology is evident on ecology as well as farmers and a popular mobilization may succeed in creation of political will for development of sustainable food production systems which benefits both the bio-diversity and the livelihood of farmers.