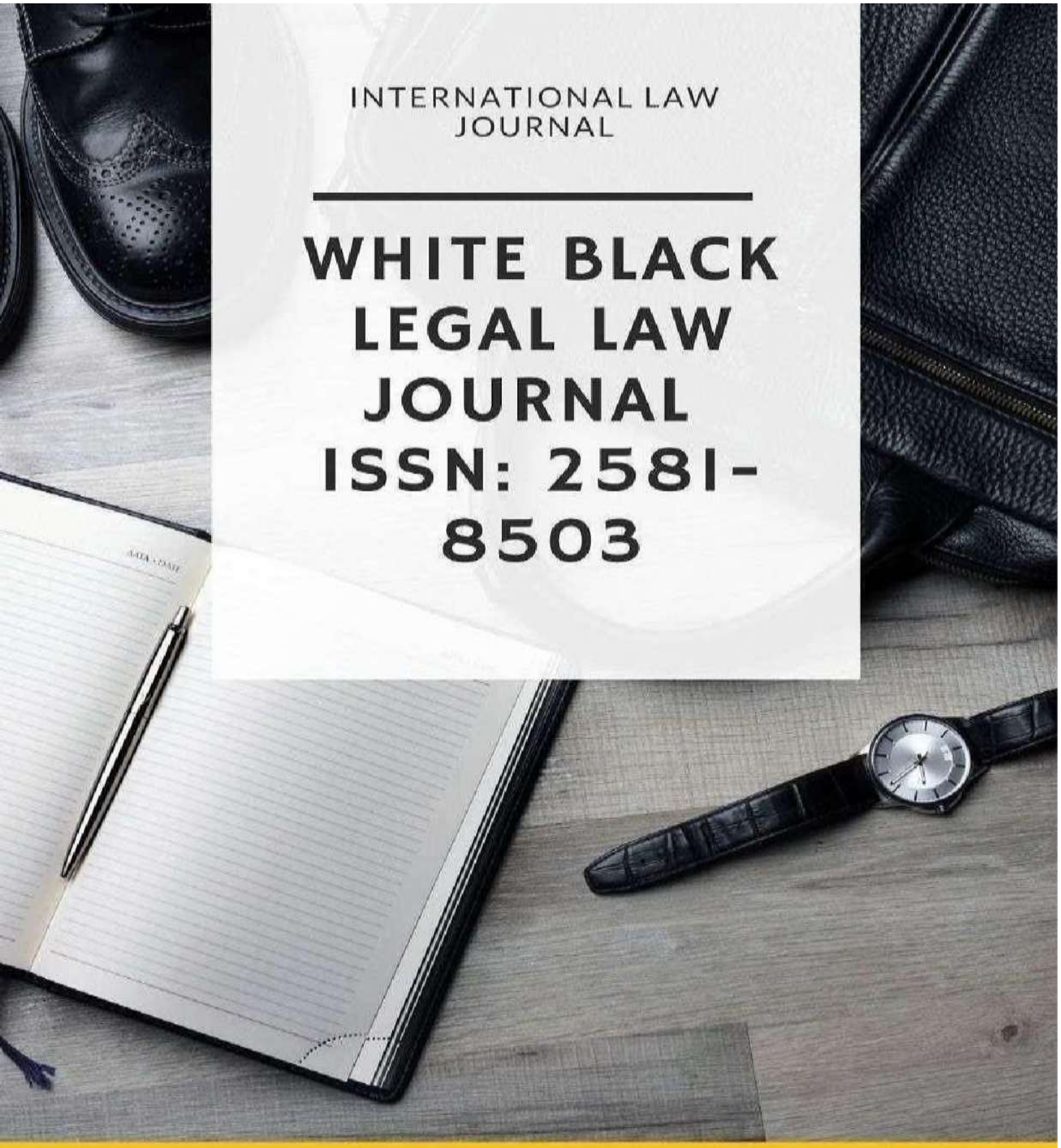

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WHITE BLACK LEGAL is an open access, peer-reviewed and refereed journal providededicated to express views on topical legal issues, thereby generating a cross current of ideas on emerging matters. This platform shall also ignite the initiative and desire of young law students to contribute in the field of law. The erudite response of legal luminaries shall be solicited to enable readers to explore challenges that lie before law makers, lawyers and the society at large, in the event of the ever changing social, economic and technological scenario.

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AN ANALYSIS ON GENETICALLY MODIFIED ENGINEERING TECHNIQUES AND FARMERS RIGHTS IN INDIA

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ABSTRACT

Genetic engineering is an emerging technological advancement that involves manipulating the genetic material of living organisms—including plants, animals, and humans—to alter existing traits or introduce new ones. In agriculture, this technology has enabled the development of genetically modified (GM) crops with enhanced characteristics such as increased yield, pest and disease resistance, and tolerance to drought. The global introduction of GM crops began in 1996, with India adopting them in 2002, starting with Bt Cotton for commercial use.

This paper explores the application of genetic engineering in Indian agriculture, focusing on the development and impact of genetically modified crops. It analyzes the benefits, including economic gains and the ability to meet modern agricultural challenges, alongside potential disadvantages such as health risks and environmental concerns. Furthermore, the project examines India's regulatory framework for GM crops and assesses the broader implications of genetic engineering on farmers' rights and livelihoods.

INTRODUCTION:

Genetic- engineering means a new type of technological advancement or an upcoming technology which uses the genetic material (gene or gene sequence) of a living organism which can be a plant, animal or human being and changes the existing characteristics or introduces a new characteristic on that particular organism. This technology involves various procedures- addition, deletion, etc. This upcoming technology has been used in plant and agricultural products.

Genetic-engineering skills in agriculture and plants have made the innovators to make plants

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and crops of different and special characteristics. These plants can be called as genetically modified crops or genetically modified plants. These crops differ from the other crops or regular crops in characteristic such as in resistance, yield, pest resistance, drought resistance, growth diseases and various other aspects. This kind of genetically modified crops was first used in the year 1996 and used in India in the year 2002. The major outbreak in genetically modified crop use in India was through Bt- Cotton. This was a genetically modified crop used for a commercial purpose.

India has various regulatory provisions for introducing this kind of genetically modified crops; these kinds of genetically modified crops or plants have both advantages such as economic advantage and satisfying the 21st century needs and disadvantages such as health risks, known and unknown to the people. This project analyses these genetically modified engineering techniques, its advantages and disadvantages over the economy of India and most importantly studies the impact over the farmer's rights.

NATURE, METHOD AND HISTORY OF THE GM CROPS IN INDIA

Genetic modification means the process of modifying an organism's De-oxy-ribo Nucleic Acid. This shall be made by modifying any organ or part of the DNA, or by addition of a new gene completely. Gene is the code in the human body which decides the characteristic of the body. Like animals, plants do have gene which helps in deciding the colour of flowers, or the tallness of a plant and various other characteristics. Like human beings, the characteristics of the parent shall be transmitted to the children and the parent plant also transfers its characteristics to the new plant through the gene. So, when a scientist genetically modifies a plant, it gets the characteristics from the parent plant and also gets the characteristic of the gene inserted. For example, a gene of bacterial resistance shall have been inserted which helps the plant to have the already existing parental genetic characteristics and the new bacterial resistance.

Genetically Modified Organisms (GMOs) shall be defined as the organism whose gene is changed or being added upon for the change of the characteristic trait which is required or desired; this process has different names such as the gene technology, DNA recombinant technology or genetic engineering and the product or the organism newly obtained shall be known as the genetically modified, engineered or transgenic organism. These new resultants

shall be of different types such as medicines, injections, nutrients, and food materials, fodders and yarns.[3]

The process of making the genetically modified organism is a little complicated and understanding the technology is a complicated science. The genetically modified organism which is a transgenic plant is demonstrating that a gene sequence of a totally unrelated plant or microbe is being inserted artificially, using rDNA technology in the plant which is selected.

Selection of plants for cultivation is not a new phenomena. In earlier days, elite plants which are high yielding and are tolerant to biotic and abiotic stresses were selected. They made variation in plants for these characteristics through mutation and hybridisation. The process of mutation and hybridisation involves process where one or two plants are crossed and the selection process was made through upbringing and only seeds with the best characteristic traits were selected. But, this process took various generations, the alteration of crop improvement took many centuries. However, to manipulate plants through selection process always will not work through unpredictability in natural selection process. Once after the technological advancements and the use of genetic engineering techniques, any person can control the process of selection in a better manner and produce crops of biotic sand abiotic stress resistance. Thus, by the advancements, scientists can now recognize, control, and activate genes for certain characteristics or traits.[4]

The steps involved in making a genetically modified organism or transgenic plants are as follows:

Organism which has that specific character is noticed and found. Followed by the process of cutting of the specific gene material that is responsible for the specific characteristic trait is identified and cut; This specific gene with the desired character has to be transferred to the already existing host plant and is done by the method of using a piece of bacterial gene which is known as the plasmid and thus, the cut gene from the found organism is sent or transferred to the host. Subsequently, another extra material called the promoter is also included with the cut gene and transferred to the host plant which ensures that the gene works properly in the

[3] Kavitha Kuruganti and G.V. Ramanjaneyulu, 'Genetic Engineering in Indian Agriculture—An Introductory Handbook', Centre for Sustainable Agriculture, Secunderabad, April 2007

[4] Malathi Lakshmikumaran, Genetically Modified plants: The IP and Regulatory Concerns in India, pp 367- 386, ARCIALA Series on Intellectual Assets and Law IN Asia Book Series, http://link.springer.com/chapter/10.1007/978-981-13-1802-7_16.

host plant. This process also includes a gene package; this gene package is sent back to the bacteria for creating the replicas of the gene packages which is happening through the process of reproduction. This is again being sent and transferred to the host plant by two methods; one is by shooting these gene packages with gold and tungsten and the other method is by using the bacteria living in the ground which is Agrobacterium tumefaciens; Thus, the host plant gets the specific gene with the desired characteristic trait and thus grows into a complete plant which has the desired trait and these kind of crops and plants are called GM crops or plants.[5]

The history of genetically modified organism or transgenic plant can be traced from mid-1960's when the scientist named Dr. Norman Boulag of Mexico developed high yielding variety of wheat, followed by the adaptation of this technology over the world. It was in the year 1966, Dr. M.S. Swaminathan, more often addressed as 'father of the Indian Green Revolution', introduced and further developed the high yielding varieties in India under the HYVP (High Yielding Varieties Programme). Adoption of HYVP overcame the problem of food crisis faced in India in the 1960's. In the early 1990's, the U.S company Monsanto offered to transfer the insect resistant Bt Cotton technology to the public sector in India, but the agreement failed to reach the mutual understanding. But then, two other projects were in process which includes the ICAR project funded by the World Bank and the project, namely the National Agricultural Technology Project and the other project was done by the Mahyco and Monsonto to develop and deliver insect resistant Bt Cotton hybrid varieties. With these backdrop, the genetically modified or transgenic plant Bt Cotton was first introduced foe commercial process in India in the year 2002 which later gave an exceptional and unparalleled outcome.[6]

GENETIC ENGINEERING AND AGRICULTURE IN INDIA

In India, there are different departments and Ministries dealing with the genetic engineering techniques and genetically engineered organisms being it transgenic plants or organisms.

Institutions, Framework, and Rules:

The ministries that deals with genetic engineering techniques and genetically engineered organisms being it transgenic plants or organisms in India are Ministry of Agriculture, Ministry

[5] https://www.biomedcentral.com/.
[6] Jayaraman. K.S, (2002) India Approves GM Cotton, Nat. Biotechnol. 20, 415.

of Environment and Forests, Department of Biotechnology and Ministry of Science and Technology;

The main regulating authority for the Agro- based genetic engineering products is the Ministry of Environment and Forests. Also by the Environmental Protection Act, 1986, the Ministry of Environment and Forests has laid down "Rules for the production, use, import, export and storage of Hazardous Micro Organisms or genetically modified organisms or cells, 1989, or in short The Rules, 1989. These rules and Regulation deals with the scope and research, application of this (GMO) in a larger scale, and such product throughout India. These rules not only states directions but also states and defines competent authority and the composition of such authorities. There are six authorities in India and are as follows:

- "Recombinant DNA Advisory Committee (RDAC) which is under the Department of Biotechnology; this is a committee under the Ministry of biotechnology for recommendations in regulating the recombinant research and uses of this technology;
- Institutional Biosafety Committees (IBSC) which is also under the Department of Biotechnology; this is a committee under the Ministry of Science and Technology, for the regulations and places or environment on which these kind of genetically engineered organism or product shall be applied and used;
- Review Committee on Genetic Manipulation (RCGM) which is under the Department of Biotechnology, is made or formed for the observation on these kind of genetically engineered products projects. It has also made procedures and regulations regarding this and regards the environmental safety;
- Genetic Engineering Approval Committee (GEAC) which is under the Ministry of Environment and Forests, is also formed for approving the product using this technology in commercialisation;
- State Biotechnology Coordination Committee (SBCC) is in every state for the inspection, investigation and other actions wherever these kind of technologically involved genetically modified organisms are used, the safety and control of these organisms are also taken into consideration.
- District Level Committee (DLC) is in districts, where the officers in those area are also involved in safety measures of these kind of organisms, use of it and impact in the environment.[7]

In addition to this, Department of Agriculture and Cooperation, has set up a task force under

[7] www.envfor.nic.in/legis/hsm/hsm3.html

the chairmanship of Dr. Swaminathan. M.S. and this force led in a recommendation for the establishment of National Biotechnology Regulatory Authority which is responsible for public inspiration, political, professional and media conference in the processes adopted for assessing risks and benefits. Also this task force recommended that the crux of the national agricultural biotechnology policy shall be done for the economy of the country, welfare of the people especially the farming families, food and health security of the people, security of agriculture and health and the safeguard of the surroundings and the international usage of farming products and goods.[8]

Regulatory Procedure for GM crops in India

Guidelines have been framed many times and some of the guidelines are:

- Recombinant DNA Safety Guidelines, 1990 by Department of Biotechnology covering research in biotechnology, field trials and commercial applications;
- Revised Guidelines for Research in Transgenic Plants, 1998 by Department of Biotechnology;
- Protocols for Food and Feed Safety Assessment of GE Crops, 2008 by Department of Biotechnology;
- Guidelines for the Safety Assessment of Foods Derived from Genetically Engineered Plants, 2008 by Indian Council of Medical Research (ICMR);
- Guidelines and Standard Operating Procedures (SOPs) for Confined Field Trials of Regulated, Genetically Engineered (GE) Plants, 2008 by Department of Biotechnology and Ministry of Environment and Forests.[9]

The Indian government analyses the organisms and crops which are genetically modified on a case basis on the basis of safety valuation and the factors are the identity, source, composition, effects of processing, transformation, expression, the consequences because of effecting the desiring organism or plant and the intake and dietary consequence of the Gm crops.

IMPACTS OF GENETICALLY MODIFIED CROPS

The impact of the genetically modified crops has different views- both positive and negative. It has a commercial value since they are high yielding and are resistant from various issues such as insects, pests, virus and herbicide tolerance. They have an impact over human health

[8] www.dbtindia.nic.in
[9] M.S. Swaminathan, 'GM: Food for thought', The Asian Age, 26 August 2009.

and the environment. By the list of the Indian GMO Research Information System (IGMORIS), the GM crops, apart from cotton and brinjal that are being currently tested are:

Genetically Modified Products	Characteristics
1. Cabbage and Cauliflower-	Insect resistance
2. Transgenic dwarf potato-	Resistant to dieseases and reduces cold inducement
3. Cotton-	Resistant to insect
4. RRF Cotton-	Tolerant to herbicide and resistant to insects
5. Corn-	Tolerant to herbicide and resistant to insects
6. Rice-	Resistant to insect
7. Groundnut-	Resistant to Virus
8. Sorghum-	Resistant to insect

Positive impacts:

- Human health dangers are solved by using the transgenic Brinjal with its in-built pest tolerant character which gives a situation where pesticides are used in a lesser amount.[10]
- There shall be a substantial increase in market yields and thus attaining higher incomes for farmers. Also, with less waste, farmers should guess to rake in an additional Rs. 4000 crore annually.
- Seeds are all based on a cost- recovery model which makes it reasonable for all farmers. Moreover, farmers shall save and reuse their seeds for the crossbreeds.[11]
- Freedom of size of farm that is it is even appropriate for small- sized farms.[12]
- Economically beneficial which shows that there is higher profits due to high yield and lessens expenses (lower cost of pesticide and herbicide, etc.).[13]
- Environmental benefits which shows the lessening of lethal chemical involvements, decrease soil erosion, growth of biological substance, lessen greenhouse gases by lessening the usage of fuel, lessening the amount of emissions and deals with environmental climate and weather change by drought-resistantance.[14]

[10] Lola Nayar, 'Ubergene Cometh', Outlook, 10 August 2009.
[11] Prakash Chandra, 'The vegetable war: GM crops will benefit farmers', The Asian Age, 22 October 2009.
[12] Brookes G, Barfoot P. (2006). Global impact of biotech crops: socioeconomic and environmental effects in the first ten years of commercial use. AgBioForum, 9, 139–51
[13] Qaim M, Traxler G. (2005). Roundup ready soybeans in Argentina: farm level and aggregate welfare effects. Agric Econ, 32, 73–86.
[14] ISAAA. (2009). GM crops: global socio-economic and environmental impacts 1996–2007. Available at: http://www.pgeconomics.co.uk/pdf/ 2009globalimpactstudy.pdf [last accessed 15 Aug 2014].

- Health and dietary benefit that is fewer revelation to lethal chemicals, less pesticide residues.[15]

Negative impacts:

- The already existing measures for the safety of the Gm crops being used shall be considered not adequate because the harmful effects of the products and GM crops when they are used in the environment are said to be changeable and vague; also, the already existing regulatory measures in India in association with this GM crops has not been evaluated the risk management in Indian situations.
- There are different health related impacts in association with GM crops such as allergies. Burning or irritating of the skin, discharges over the body, swollen faces etc, are the allergies that have already been testified and noted because of the usage of the Bt cotton. There are certain potency related issues and milk production problems in cattle because of the cotton cattle feed.[16]
- Availability and accessibility which includes the complications in Research and Development, higher charge of GM seeds and the scarcity of the supply system and the lack of data about application of GM technology.[17]
- Guidelines and market which is prominent to cartels by patents on genes and partial world-wide market due to rising skepticism toward GM foods.[18]
- Socio-economic concerns which is disrupting traditional cultivation systems.[19]

The problems of Genetically Modified crops may be categorised of three different aspects- socio- economical, technical and political. As far as the socio- economic aspect is concerned, the GM crops shall have to be tested in suitability to the agricultural, environmental and appropriateness for the small scale farmers; only upon the suitability, the crop shall be extended to other areas and then shall commercialised; the suggestion and conclusion shall deal with the following aspects.

[15] Bouis H. (2007). The potential of genetically modified food crops to improve human nutrition in developing countries. J Dev Stud, 43, 79–96.
[16] Latha Jishnu, 'Farmers' resounding no to Bt bringal', The Business Standard, 22 October 2009.
[17] Glover D. (2009). Undying promise: agricultural biotechnology's propoor narrative, ten years on. STEPS Working Paper 15. Brighton: STEPS Centre.
[18] Paarlberg RL. (2002). The real threat to GM crops in poor countries: consumer and policy resistance to GM foods in rich countries. Food Policy, 27, 247–50.
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CONCLUSION AND SUGGESTION

Genetic engineering and its use in agriculture particularly in the framework of India, where bulk of population be determined by agriculture as a backbone for livelihood, includes many demands. Food and Agriculture Organisation (FAO) has stated about this in the year 2004, that knowledge and advancement in science shall never be without risks and genetically modified products also decreases the agricultural hazards which is related to agriculture; but, still increases other new risks which is because of these advancements of technology in genetically engineered products. The places to use these kind of new products shall be decided by the people and the society. The consequences of the usage and application of Gm crops and products shall be both largely productive and largely negative effect. There are rules and regulations by the government which just tests the GM products and its credibility in its usage and application and the commercial motivation of that product shall not be considered in the valuation of the product.

Suggestions for new law by the Government shall be made which purposeful, clear, transparent and predictable; it shall be non- political, efficient and in consistency with the international conventions and agreements and the provisions shall be clear with the ongoing transitions based on the current situation. Also, Government shall even spread awareness about the GM crops, its making, production and the process involved to all the farmers through different organisations such that each and every farmer is known about the product, seed and crop. Followed by complete assessment of the crop, seed or product which is its benefit and the disadvantage that may be cause and only if the seed benefits are more, that shall be introduced and commercialised.

To conclude with the statement of Dr. M.S. Swaminathan that the genetically modified organisms or products shall be able to give the solution to many problems such as hunger, nutrition problems, yielding in a higher amount and also protecting the environment and biosphere by decreasing the usage of chemicals such as pesticides and fertilisers. But, then there are certain problems relating to these kind of products which the government shall regulate.[20]

[20] M.S. Swaminathan, 'GM: Food for thought', The Asian Age, 26 August 2009.

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