Indian Journal of Natural Sciences (IJONS)

Volume XIV (14) October 2023
CODEN: IJONS (80) (2023) ISSUE 80 ISSN: 0976 - 0997

CONTENTS

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.14 / Issue 80 / Oct / 2023 *International Bimonthly (Print) – Open Access* *ISSN: 0976 – 0997*

49

RESEARCH ARTICLE

Sustainable Agricultural Production through Genetic Engineering Technology in India: A Need

Shaheema A. S*

Assistant Professor, SDM Law College, Centre for Post Graduate Studies and Research in Law, Mangaluru, D.K District, Karnataka, India.

Received: 04 Aug 2023 Revised: 21 Aug 2023 Accepted: 07 Sep 2023

***Address for Correspondence**
Shaheema A. S
Assistant Professor,
SDM Law College,
Centre for Post Graduate Studies and Research in Law,
Mangaluru, D.K District,
Karnataka, India.

ABSTRACT

For the growing population in India the demand for food is increasing and there are several questions arising on the agricultural productivity but there is a need to provide a fruitful response to the questions in a sustainable way. Every Indian farmer needs to overcome the impact of various agriculture-related issues while growing crops. The modern genetic engineering technology provides a solution for increasing agricultural production sustainably. At the global level, several varieties of genetically modified crops with the application of genetic engineering technology are identified, developed, and commercialised, but the same are banned in India and the moratorium is imposed especially on genetically modified food crops. The author in this article focuses on the importance and benefits of genetically modified crops produced through genetic engineering technology to the Indian farmers and to resolve food insecurity problem.

Keywords: Agriculture, Genetic Engineering, Technology, Farmers, Resistant

INTRODUCTION

For sustainable agricultural production, the application of genetic engineering technology in the cultivation of crops as a modern technology benefits the present and future generations. The World Commission on Environment and Development (WCED) defined the term 'Sustainable Development' as, *"the ability of humanity to ensure that development meets the needs of the present without compromising the ability of future generations to meet their own needs"*. Sustainable development seeks to ensure that economic, social, and cultural rights will be realized in the future,

Indian Journal of Natural Sciences *www.tnsroindia.org.in* ©IJONS

Vol.14 / Issue 80 / Oct / 2023 *International Bimonthly (Print) – Open Access* *ISSN: 0976 – 0997*

which means that the conditions for their realisation also need to be fulfilled. Like sustainable development principle genetic engineering technology as an innovative technology guarantee sustainable agricultural production benefitting both farmers and consumers.

Problems Relating to Sustainable Agricultural Productivity in India

For Indian people, agriculture is the sole and most important means of livelihood, accounting for 58 per cent of direct or indirect employment. In developing countries, the fact is that rural incomes can grow to profitable levels only when the percentage of the population dependent upon agriculture is no more than 5 per cent. Such a change requires the consolidation of individual farm holdings to 15-20 hectares and the transformation and mechanization of farm operations. There is hardly any scope and hope for such a development in the current political climate in India. The per capita availability of agricultural land is expected to go down from the present 0.29 hectares to 0.23 hectares by 2025 and 0.19 hectares by 2050, due to the increase in population. This situation seriously affects agricultural production and food security in India and could be partly compensated by (1) reclaiming 12 million hectares of degraded land, (2) bringing under cultivation most of the 13 million hectares of cultivatable wasteland, and 29 million hectares left as uncultivated, both by enhancing the strength of soil and irrigation and by setting out modern technologies. Efforts should also be made to use 17 million hectares of presently uncultivable barren land, through technological innovation.

At the international level, the developed countries have made sufficient improvements towards sustainable agricultural yield because of low population growth, substantial areas of land, sustainable agricultural practices like less or no-ploughing are widely practised, and appropriate crop rotation is in place. But in India the situation relating to sustainable agricultural production is completely different. Several challenges for sustainable agriculture production are faced by Indian farmers because of the extensive use of chemicals and erroneous use of water resources. The maximum waste of water occurs in the areas in which crops are grown under irrigated situations. In Northern part of India, wheat and rice are produced continuously in the greatest agriculturally productive regions. Whereas, in the Southern part the water is much scarcer and in the traditional rice-growing areas of Eastern part constant rice cultivation is practised whenever irrigation benefit is available. Above all the stated problems the groundwater levels in several parts of India are diminishing and the subsoil water quality is deteriorating in several places.

The cultivation of wheat and rice are the source of the large monetary expectation of Indian farmers. There are less governmental policies on grain acquirement and less monetary support for power, irrigation, and fertilizers. Due to the deficiency of proper crop rotation in wheat/rice growing fields, the manifestation of pathogens and pests have increased. Also, farmers are excessively using agrochemicals like pesticides and fungicides. Extensive use of agrochemicals for longer time poses a substantial risk to the wellbeing of farmers, consumers, flora, and fauna. Sustainable agriculture productivity involves suitable crop rotation technique. Improving the production of crops such as pulses, coarse grains, and oils seeds are vital for nutritional security and the same will lead to addressing the problem of extreme use of water and high input costs.

Problems Relating to Irrigation in India

Agriculture in India is still affected by the vagaries of nature, i.e., monsoon failures leading to crop losses and to leaving more land in the drier areas uncultivated. The net irrigated area increased from 31.1 per cent in 1970-71 to 64.8 million hectares in 2017-18. which is insufficient, even for the current needs. The main reason for the depletion of groundwater is the excessive utilization of bore wells and more particularly in central and northern India. It is estimated that 17 per cent of the Indian population and 22 per cent of the geographic area will be facing water scarcity by 2050. Supplementing the irrigation perspective is the key to sustainable agriculture production. Cultivation of pulses, oilseeds, and millets produced in the drier regions of the country, would significantly increase with extended irrigation facilities.

Indian Journal of Natural Sciences *www.tnsroindia.org.in ©IJONS*

Vol.14 / Issue 80 / Oct / 2023 *International Bimonthly (Print) – Open Access* *ISSN: 0976 – 0997*

Problems Relating to Food Grains Productivity in India

Production of food grain in India rose from 52 million tonnes in 1951-2 to 284.83 million tonnes in 2017-18. Though the volume of food production has shown upward trends, the yields have been low to cop-up the food need of the present Indian population. There is a need for India to realize its full potential for agricultural production, which can be made good only by technological innovation. Improving agricultural practices, research, irrigation, and infrastructure development to scale up productivity is a serious challenge for India.

Genetic Engineering Technique and Sustainable Agriculture Productivity

Genetic engineering techniques have the potential to help to ease problems relating to agriculture through genetically modified crops that can preserve habitations by enhancing agricultural productivity on existing farmlands, land renovation approaches, and so on. Genetic engineering technology reduces input costs in agrochemicals and protects the environment from the accumulation of chemicals which are used for controlling pathogens and pests.

Specific Traits in the Genetically Modified Crops

The genetically modified crops available on the international market today have been designed using one of four basic traits, such as; resistance to insects/pests, resistance to disease/viral infections, tolerance towards certain herbicides, etc.

Insect/Pests Resistance Crops

In the major parts of the world and mainly in the developing countries the insects or pests are main causes of destruction of crops. More use of pesticides and fertilizers leads to water and soil contamination and the same will result in loss of soil fertility and damage the environment. It will even impact consumers that they scare to eat food produced from the use of pesticides because of the potential health risk. Genetically modified crops are the substitute for chemical pesticides, which are pests resistant, such as Bt corn, Bt cotton, Bt soybean, Bt Brinjal, Bt Mustard, and so on. They help to protect the plants from getting damaged by insects and pests. By growing genetically modified crops various adverse effects using a chemical pesticide can be controlled such as reduced damage to soil, the high cost of bringing a crop to market, etc.

Resistance to Disease/Virus Infection

Disease/virus infection of crops is one of the significant causes that result in a massive loss to farmers and impact the availability of food and threatens food security. Diseases in crops are because by viruses, fungi, and bacteria. Resistance to pathogenic viruses is accomplished by incorporating genes for viral coat proteins and several other options, which effectively inhibit the multiplication of the virus. Genetically modified crops with resistance power to diseases, for instance, a viral protein Tobacco Mosaic Virus (TMV) has been introduced to develop GM tobacco, and this GM tobacco is resistant to TMV.

Herbicide Tolerant Crops

To remove and destroy weeds, farmers use large quantities of herbicides (weed killers). With care and due diligence, weeds must be removed by using herbicides, and it is a time-consuming and expensive process. For weed control, the crop is made herbicide resistant/tolerant by engineering relevant genes 'into' it and spraying the field with herbicide. The weeds are killed while the crop is left unharmed because of its genetic resistance. Herbicide tolerance helps the use of herbicides over genetically modified crops, e.g., soybean, cotton, maize, sugar beet, and canola, allowing the crop to remain unharmed while weeds are controlled. The farmers involved in producing genetically modified crops require only one application of weed killer instead of numerous applications, and the same will benefits them in reducing the production cost and restrict the danger of agricultural waste run-off.The glyphosate-tolerant crop is the leading commercial herbicide-tolerant trait. Other herbicide-resistant crops have been developed called herbicides resistant tobacco, tomato, potato, and cotton. Several herbicide-tolerant crops are undergoing regulatory review. The labour-saving technology in the herbicide-tolerant crops benefits farmers with more income than usual. Developed countries apply this technology for abridging weed control procedures and thus reducing a

Indian Journal of Natural Sciences www.tnsroindia.org.in ©IJONS

Vol.14 / Issue 80 / Oct / 2023 International Bimonthly (Print) – Open Access ISSN: 0976 – 0997

labour-intensive weeding practice. As Bt cotton is the only commercialised genetically modified crop in India, there is a significant gain regarding improved production and decreased use of pesticides.

Cold Resistant Crops

Genetically modified tobacco and potato are also cold-resistant crops; unexpected coldness can obliterate subtle seedlings. Genetically modified tobacco and potatoes are inserted with antifreeze gene from cold water fish so that these crops could tolerate cold temperature that usually kills unmodified seedlings.

Drought Tolerant/Salinity Tolerant Crops

Farmers usually find the difficulty in growing the crops in the previously unsuitable lands for cultivation. Thus, to overcome this situation the drought/salinity tolerant genetically modified crops withstand for longer period and this feature in the crops help farmers to grow crops in the previously unsuitable land for agriculture.

Genetically Modified Crops and Environmental Management

Genetically modified crops help in environmental management as soil and groundwater pollution are continuous issues in most parts of the world. To manage environment few plants for example poplar trees have been genetically modified to crackdown substantial metal pollution from contaminated soil.

Delayed Ripening Crops

Fruit crops are genetically modified with delayed ripening benefits in them. For instance, genetically modified tomatoes with delayed fruit ripening preserve the fruit for more days, these tomatoes are high in sugar and without any fear of spoilage can be transported to far-away markets. These genetically modified tomatoes are helpful in food security. Through delayed ripening genetically modified crops also helps in post-harvest losses to farmers and the same will enhance productivity improving farmers' income and providing food security. For the improved income level of people and more awareness on health and nutrition in the coming years there is a need for substantial increase of vegetable and fruit crops. For combating the issues of post-harvest losses and food insecurity, the contribution of genetically modified crops will be much appreciated.

CONCLUSION

As discussed above, genetic engineering techniques in agricultural production offer many advantages with so many potential benefits to Indian farmers and increase agricultural yield and combat the threat to food security. But, a moratorium on the commercialisation of genetically modified food crops in India is restricting them from making use of the potential benefits of genetic engineering technology. Thus, the proper use of genetic engineering technology will be a great help to comprehend sustainable agricultural productivity and food security in India.

REFERENCES

1. Annual Report by Department of Agriculture, Co-operation and Farmers Welfare Ministry of Agriculture and Farmers Welfare, Government of India (2017-18) Retrieved from: www.agricoop.nic.in
2. Chopra, V.L. (2002). Improving the Genetic Produce Bio-technology in Crop Productivity, *The Hindu Survey of Indian Agriculture*, 228.
3. Dahleen, S. Lynn *et. al.*, (June 2001). Transgenic Approaches to Combat Fusarium Head Blight in Wheat and Barley, *Crop Science* 41(3), 628.
4. Deborah, B. Whitman (April 2000). Genetically Modified Foods Harmful or Helpful? *CSADiscovery*, 1-13. Retrieved fromhttp://www.csa.com/discoveryguides/discoveryguides-main.php.
5. Zhang, H.Z (Aug 2001). Transgenic Salt Tolerant Plants Accumulate Salt in Foliage. But not in Fruit. *Nature Biotechnology* 765.

6. HidenOhkawa *et. al.* (Sep, 1999). The use of Cytochrome Genes to Introduce Herbicide Tolerance in Crops.*Pesticide Science* (9), 567.
7. Kameswara Rao, C. (2013). Genetically Engineered Food Crops Would Ensure Food Security. In David J. Bennett and Richard Jennings C (eds.), *Successful Agricultural Innovation in Emerging Economies: New Genetic Technologies for Global Food Production*, (p.169) Cambridge University Press, Cambridge.
8. Ministry of Finance, Government of India Report on Agriculture (Economic Survey, India Budget), (2012–2013). Retrieved from: www. indiabudget.nic.in/es2011-12/echap-08.pdf.
9. Moellenbock, D J. *et al.* (2001) Insecticidal Proteins from Bacillus Thuringeinsis Protect Corn from Corn Root Worms.*Nature Biotechnology*, 19(7), 668.
10. Nagendra Prabhu, G. (July-Dec 2003). Indian Initiatives in Biotechnology *SAJOSPS96-97*.
11. Parthasarathi, M. (2012). *Genetically Modified Crops*, New Delhi, Bio-Green Books.
12. Qaim, M (2009). The Economics of Genetically Modified Crops. *Annu Rev Res Econ 1*, 665–693.
13. Ramesh Chand (2005), *Indian's Agricultural Challenges: Reflection on Policy, Technology, and other Issues*. New Delhi: Centad.
14. Shantanu Jugtawat. *Genetic Engineering and International Law Development - An Introspection*. Retrieved from www.nliu.com/new/art6.pdf.