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Challenges of Food Security in India and Importance of Intellectual Property Rights (IPR)

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Abstract

The rapid changes of Indian Economy had little impact on food security since independence. The wide spread famine, erratic monsoon and traditional farming pattern are unable to cope the growing demand for food. It is obvious that India's performance with respect to hunger is abysmally low not only in connection other developing countries like China but even in corresponding to the rest of South Asia. This paper analyzes one possibly and key factor to address food security of India: accelerating the deployment and development of improved crop varieties through utilization of leading technologies in agriculture including, biotechnology, genetically modified crops and plant tissue culture procedures. The vital question of agricultural biotechnology and its impact on food security is assessed carefully. This includes the interaction of Intellectual Property Rights (IPR) laws, treaties, policies and the management in agricultural research and development both in public and private sector. The tests Chi Square test is applied to derive the conclusion. It has been concluded that India needs the genetically modified (GM) crops to meet the challenges food security with proper policies, programs and precautions.

Key words: 1. Agricultural Biotechnology, 2.Food security, 3.Genetically Modified (GM) crops , 4.High Yielding Variety(HYV), 5.Intellectual Property Rights (IPR), 6.Protection of Plant Variety (PPV).

Introduction

Ironically, many developed Nations believe that reduction in agriculture's share in GDP leads to economic growth. While most of the developing countries are suffering from malnutrition, the question of food security is of great concern in these countries. IPR's contribution to food security through genetic engineering is mostly debatable. IPR in itself is highly beneficial in encouraging innovation, invention, research and development.

But the contributionofgeneticallyengineeredfoodtowardshealthisdebatable.

The developed countries took the advantage of IPR by patenting their inventions while developing countries like India followed their traditional pattern of agriculture. But the adoption of the TRIPS Agreement and the introduction of life patents in all WTO member states constituted an important step towards a complete change of

policy with regard to agriculture. This gave an opportunity to the private sectors to play a leading role in generating income. But the basic purpose of IPR to develop a scientific temper and reward for new inventions seems a distant dream. The plant variety protection and farmer's right actisaninitiativetobenefitthebreedersandfarmersofIndia.

Objective and Methodology

The present paper makes an effort to establish a link between IPR in agriculture and food security in an agriculture Economy like India. The introduction of patent in agriculture has open eddiverse opportunities and scopein agricultural biotechnology.

While trying to establish the relationship, the study undertakes an opinion survey. Primary data is collected from agricultural scientists, academicians and NGOs, across India. The sample size is 300 which is 100 participants of each category. The questionnaire emphasized on the followingissues-

- The adoption of IPR will enhance the transfer of technology and India can take the benefit out ofit.
- StrongimplementationofIPRinagriculturewillpromotetheresearchactivitiesinIndia
- Whether,thecostofthefoodproductsmaybeincreasedduetomoderntechnology.
- TheroleofIPRinIndianagriculturetoprovideaboosttofoodsecuritysystemof India.

The Chi-square test is applied to analyses the data.

The Management of Plant Variety

In developing countries, agriculture is the mainstream of the economic activity. In India it is recently faced next phase challenges of green revolution ,with that other challenges like, decrease in total factor productivity, increase in cost of production for agriculture, crops affected by pests and diseases, depletion of natural resources and last but not least lack of food with nutritional value.(Government of India, 2019) In India, even though the share of agriculture in GDP has declined to 16.5 in 2019-2020, relatively fast in the past few decades still employs an overwhelming majority of the population, about 54.6 percent(census 2011). The sector not only provides direct employment to farmers but also indirectly provide employment to a large number of people many subsidiary sector, which Therefore development of agricultural activitycanleadtogrowthinmanyotheragriculturalalliedsectors.(Ministry of Finance,2020)

IPR mostly deal's with agricultural diversity and its protection, which is affected by various factors. Usually, the farmers play a major role in conserving and enhancing plant varieties. In developing countries, the farmers are main actors in saving seeds, selecting specific traits to produce variety according to their requirement. It is mostly the rural farmers who are engage in conserving seeds from the earlier crops. In India, the estimates vary from twenty three to eight five percent. Seed industries provides various kinds of seeds in different amounts like paddy (twelve percent),wheat (eight percent),Maize (twenty nine percent),Pearl millet (seventy two percent).(Shiva and Tom,1998) Estimates indicate that the inner farmer sales if seeds account sixty percent of the seeds requirement of agriculture in India. Farmers can exchange the seeds amongthemselves.

While farmers have managed plant varieties for many centuries, government progressively also became involved in seed management. In the United States, the government took up an important role in the nineteenth century and there is a significant government effort to provide good seeds to farmers up to the beginning of the twentieth century. More recently however, plant variety conservation and enhancement have been undertaken by different other actors like private companies, government and the Consultative Group of International Agricultural Research (CGIAR). In India, asignificant effort was started in the 1950s to improve the distribution of varieties of seeds to the farmers by the government by setting up farms to multiply these varieties. Research on maize, sorghum, and millet led to the development of first maize hybrid adapted to Indian conditions.(Rao,2004) National seed's corporation wasestablished, to produce processand market single crosses of hybridseeds.

The domestic private sector in developing countries has followed varied fortunes but has often been a secondary actor in plant variety management. In India, this industry develops because of Government action in this field which is largely confined to the development of hybrids.(Pal and Tripp, 2002) Seed industry only started taking part in plant breeding from the mid-1980s. At that point, the government took a decision to stimulate the development of the private sector in the seed industry. This was first reflected in the introduction of the New Seed Policy. Later on, the introduction of a New Economic Policy in 1991 provided further incentives for the private seed sector. The results have, for instances been rapidly visible in the case of maize seeds where the market share of private seed companies rose from ten percent in 1981-85 to eight five percentby1995-97.(Gerpacio, 2001)

With this policy of Government, the farmers lost the independence. In contrast, it increased the monopoly of breeders' rights. In this situation, India should not follow the Union for protection of new varieties of plants (UPOV) blindly. (Rachitta.P, 2008) It should choose a system, which will help in protecting the Indian breeders and farmers and facilitate a mutually beneficial international collaboration. According to Dr. M.S. Swaminathan, India should consider economics and ecology along with "equity and employment. It must be pro-nature, pro-poor, pro-rural, and pro-women because women play a significant role in the seed selection, saving and propagation." The Plant Breeder's Right legislation should retain breeder's exemption, strengthen farmer's privileges and provide a mechanism to give operational context to the Farmers Rights.(Tyagi and Janaki,1998)

Traditionally available varieties of seeds, which are under cultivation and are found in India, are to some extent registered under Farmer's Rights Act 2001. The farmers otherwise might have to face a high cost of cultivation and it would hamper the growth of agriculture. These traditional seeds should not be covered under any new kind of patent or protection and should be freely available for farmers use. These are the property of the farmers who have applied their skill and ingenuity to develop them. Breeders from underprivileged rural and tribal communities must also be rewarded for their Contributions to successfulbreeding.

Moreover, the plant breeders for the development of new genotype should be rewarded.(Tyagi and Janaki, 1998) A variety may contain land, races or folk varieties from different parts of a country or several countries. This makes it difficult to operate a system offarmer'srightswiththeinternationalscopeundernationallaw.

Food Security and Plant Variety Protection

Currently the amount of food in security has globally reduced. The trend can be offset because of "increases in population, and diminishing land availability" for agriculture. Ensuring food security is essential but not at the cost of cash crops, encroachment of private land or endangering livelihood. Thus, providing food to every citizen of nation is a challenge for every developing nation. To meet the challenge the Government of India introduced Public Distribution System, imported food grains and adopted HYV. Therefore, diversification in agriculture can increase income and food security simultaneously. Agro diversity also indirectly helps in "fertility increase pollination, and nutrient enhancement, diseases and insect management and water retention"(Thrupp,2000)

In order to maximize productivity and minimize the risk, The farmers have made certain selections by preserving old varieties, invented new varieties, with that adapted existing varieties to suit their environment, to enrich ago-biodiversity. The state should directtheprivatesectorsnottointerrupttheassetsoffooddeprivedindividuals.

Biotechnology and Genetic Engineering

Biotechnology refers to alteration of living organisms it's process and final output.(Barnum,1998) A few of the scientific technologies involve "micro propagation, tissue culture, cloning, artificial insemination and embryo transfer". Genetic engineering is applied when an expected characteristic is found to be incompatible. Genetic engineering also involves techniques to upgrade crop plant varieties. One of the gift of genetic engineering isBacillusthuringiensis (BT),whichisatoxinproducingbacteriuminjectedincropsto make them pest

resistance.(Cullet, 2005) This has been widely accepted by Indian farmers.

Overview of Agricultural Biotechnology in India

Encouraging farming in developing countries is the way to attain food security. It is possible by expanding investment in farming, development in administration of international trade,extend access to food and enlarge food productivity by natural resource preservation. To authorize these four ,there is need of expansion of technology. Biotechnology is one of them.(Ruane and Sonnino,2011) Agricultural technologists have adopted scientific tools for production of crops, forestry, and marine lives and cattle cultivation.(FAO 2004,Herdt et al,2007) Biotechnology is of two types: (i) cellular approach mostly used on cattle's (ii) molecular approach which includes genetic engineering, bio informatics, genomics, diagnostic procedure and molecular marker's technology.(Reece andHaribabu, 2007)

Through biotechnology scientists have developed seeds that can be cultivate in drought Proneareaandordryland."DrylandagricultureinIndiacovers67percentofthenet cultivated area and currently accounts for more than 60 percent of food grains (90-95 percent of millet), 90 percent of green legumes, almost 80 percent of oil seeds, and 70 percent of cotton. Even 50 percent of paddy is grown under rain-fed conditions. Increasing the productivity of dryland agriculture becomes highly essential also for the reason that only the improvement in the productivity of dry land agriculture can lead to benefits of growth being shared by many".(Rangarajan, 2002) Green revolution and its success is controversial in nature, because it was not able to solve the above issue related to dry land. Agricultural biotechnology can solve theproblem.

According to International Service for the Acquisition of Agriculture Biotechnology Applications (ISAAA),"India has the world's fourth largest GM crop acreage surpassing China's 3.0 million hectares(mh) , while it is almost equal that of Canada's 11.6 mh, mostly on the basis of GM Cotton, the only genetically modified crop which is permitted in India to cultivate.(Reddy and Krishna,2018) The farmers of India in 2014, planted atotal 11.6 mh under transgenic .Significantly, the entire 11.57 mh GM crop area in India last year consisted of Bt cotton, most of which (about 96 percent) is now cultivated by Bt hybrids....China has cultivated 3.9 mh area with GM planted under Bt cotton. But the govt. has permitted for commercial cultivation of seven other crops like –papaya, rice, maize, petunia, tomato and sweet pepper etc."(The Indian Express, February 2,2015) But in India there is no new entrant of GM crops, except BT cotton and BT brinjal. According to ISAAA, "India spends roughly around $12 billion annually on vegetable oil imports. GM mustard has been considered by agriculture experts as a solution for the country's edible oil deficit because it has yields up to 30 percent higher than the normal varieties."

BT cotton is widely adopted across India. It generates an annual average profit of fifty billion US$. It consumes less labor per area; it is Eco friendly, simultaneously generating moreincome.Thishasattractedprivatesectortocollaborateeachotheracrosstheglobe.

Though Bt brinjal is the first GM vegetable crop of India yet is severely infested by fruit and shoot Borer. Because of this it yields an annual loss of seventy percent. According to Marichamy and Ganesan (2003) the Bt brinjal has the capacity to deal against"Fruit and Shoot Borer(FSB),with yield losses of up to 70%. The Bt eggplant technology is useful against FSB, with 98% insect mortality in shoots and 100% in fruits, at the same time requiring 77% less insecticides than non-genetically engineered control eggplant; there are also up to 116% increase in yield over conventional hybrids and 166% increase in Open Pollinated Varieties (OPVs), with a decrease in insecticide application, reducing farmers' exposure to chemicals and pesticide residues in the vegetable itself. It is calculated that farmers should achieve a net economic benefit of Rs.16,299(US$330) to Rs.19,744(US$397) peracre from Bt eggplant."(Krishna and Quim, 2007)

Brassica oleracea is another such example whose annual production is affected by diamondback moth infestations.(Hennessey.,et.al ,2014) Which leads to a huge loss about sixteen million US Dollar (Hennessey.,et. al, 2014). In India ICAR, Bayer Crop Science and Collaboration on Insect Management for Brassicas in Asia and Africa (CIMBAA) have come together for expansion of BtBrassica.

Data Analysis

To know whether IPR in agriculture helpful to provide food security a populated country like India, a Primary survey was conducted. A structured questionnaire was prepared to collect views of respondents. Every question contains a hypothetical statement and it is proved whether the statement is correct or incorrect. The misconceptions of people regarding GM food, food security have beenanalyzed.

Q1.Do you think the adoption of IPR will be able to enhance the transfer of technology by which Indian agriculture will bebenefited?

Ho: The adoption of IPR will not enhance transfer of technology by which Indian agriculture will takeadvantage.

Table- 1: Enhancement of Transfer of Technology through IPR

Respondents	Yes	No	Total Responses
Scientists	90 (90)	10 (10)	100 (100)
Academicians	94 (94)	6 (6)	100 (100)
NGOs	78 (78)	22 (22)	100 (100)
Total	262 (87)	38 (13)	300 (100)

Source: Author's own calculation (Figures in parenthesis represent percentage of total)

It is generally presumed that when MNCs will enter into Indian agriculture they will bring new technology with them. It may enrich the technical know-how of Indian farmers. Table- 1 represents views of different groups of respondents on the effect of IPR on the issue of transfer of technology. A glimpse of the table reveals that Ninety percent of scientists did agree that India can take benefit out of transfer of technology Ninety four percent academicians and seventy eight percent NGOs were agreed. In total out of two hundred sixty two numbers of respondents said yes and thirty eight of them said no to the statement. In order to find out whether there is any significant effect chi-square test is applied.

The result is highly significant ($\chi^2 = 12.5352$, d,f. = 2, P = 0.001897). Hence we may reject the null hypothesis at five percent. So we may conclude that IPR will enhance transfer of technology and India can take the benefit out of it.

Q2. Do you think strong implementation of IPR in agriculture will promote the research activities inIndia?

Ho: Strong implementation of IPR will not promote the research activities in India.

Table- 2: Promotion of Research Activities in India.

Respondents	Yes	No	Total Responses

Scientists	92 (92)	8 (8)	100 (100)
Academicians	96 (96)	4 (4)	100 (100)
NGOs	80 (80)	20 (20)	100 (100)
Total	268 (89)	32 (11)	300 (100)

Source: Author's own calculation (Figures in parenthesis represent percentage of total)

The agricultural research activities are mainly controlled by Public Sectors in India while it is done by private companies in western countries. It is a common belief that the introduction of the patent in Indian agriculture and stronger implementation of its provisions will enhance the research activities in Indian agriculture. Table-2 represents views of a different group of respondents regarding the effect of strong IPR implementation on research activities there in. A detailed study of the responses depicts that ninety two percent of scientists agreed that research activity in India will be promoted while eight percent of them did not agree. From Academicians, ninety six numbers of respondents agreed and four of them disagreed and in case of NGOs, eighty percent agreed while only twenty percent did not agree to the statement. Out of total respondents, eighty nine percent of respondents are of the view that implementation of IPR leads to increase in research activity in India whereas eleven percent did notagree.

The result is significant ($\chi^2 = 14.5522$, d,f. = 2, P = 0.000692),at five percentage level and the null hypothesis is rejected. So it may be concluded that strong implementation of IPR will promote research activities inIndia.

Q3.Do you think modern technology will increase the cost of thefood products?

Ho: The cost of the food product may not increase due to modern technology.

Table- 3: Increase in Cost of Food Product

Respondents	**Yes**	**No**	**Total Responses**
Scientists	28 (28)	72 (72)	100 (100)
Academician	42 (42)	58 (58)	100 (100)
NGOs	26 (26)	74 (74)	100 (100)
Total	96 (32)	204 (68)	300 (100)

Source: Author's own calculation (Figures in parenthesis represent percentage of total)

The people fear that the introduction of new technology in the agricultural sector may affect the cost of food products. Use of GM food products is expected to increase price .In Indian context maximum people are living below poverty line. It may be difficult for them. Therefore there is apprehension among thescholars.The

introduction of new technology will increase the cost of food products which cannot be affordable by the poor people. This is the presumption of a certain section of intellectuals. But the majority of Scientists, Academicians and NGOs are of opinion that the patent in agriculture will increase the production per hectare. Table-3 represents views of a different group of respondent about an increase in the cost of food products twenty eight percent scientists said yes to the statement and seventy two percent said no, Among Academicians forty two of them did agree and fifty eight respondents disagreed and in case of NGOs twenty six respondents agreed, seventy four disagreed to the statement. In total out of 300 respondents, thirty two percent were agreed to effect of the patent on increasing the cost of food products whereas sixty eight percent disagreed with this statement.

It is not significant ($\chi^2 = 6.9853$,d.f = 2, P = 0.03042) at five percent level. We may accept the null hypothesis and conclude that the cost of food product may not increase due to moderntechnology.

Q4. Do you think presence of pesticide, herbicide in Genetically Modified crops will benefitthefarmersasitreducesthecostofproductionperhectare?

Ho: Genetically modified crops are not beneficial to the farmers in case of reduction in cost of production.

Table- 4: Suitability of GM Crops.

Respondents	Yes	No	Total Responses
Scientists	90 (90)	10 (10)	100 (100)
Academicians	74 (74)	26 (26)	100 (100)
NGOs	94 (94)	6 (6)	100 (100)
Total	258 (86)	42 (14)	300 (100)

Source: Author's own calculation (Figures in parenthesis represent percentage of total)

Some people advocate that the cost will be increased in GM crops because it will demand more fertilizers, herbicides, and pesticides etc. but protagonists surmise that it will reduce the cost per hectare because it will demand fewer fertilizers, no herbicides, and pesticides. In Table-4, around eighty six percent respondents including ninety scientists, seventy four academicians, and ninety four NGOs support the view that it will reduce the cost of production. Only fourteen percent responds reject this view. In order to find out the result chi-square test isapplied.

The null hypothesis is rejected at five percent level of significance. The result is significant ($\chi^2 = 18.6047$,d,f.= 2,P =0.000091). So it can be conclude that, the genetically modified crops are suitable for benefit of the farmers by reducing the cost of production per hectare.

Q5. Do you think the patent in Indian agriculture will provide a boost to food security system ofIndia?

Ho: Patent in Indian Agriculture will not boost up the food security system of India.

Table- 5: Patent in Indian Agriculture and Food Security System of India.

Respondents	Yes	No	Total Responses
Scientists	72 (72)	28 (28)	100 (100)
Academicians	48 (48)	52 (52)	100 (100)
NGOs	74 (74)	26 (26)	100 (100)
Total	194 (65)	106 (35)	300 (100)

Source: Authors own calculation (Figures in parenthesis represent percentage of total)

The issue of food security is a major concern for India. The patent in Indian agriculture will give a boost to the production of agriculture. Table-5 represents the views of the different group of respondents regarding the effect of the patent in Indian agriculture on food security system of India. A detailed study of the table shows that seventy two percent of scientists agreed that patent in Indian agriculture will boost food security system of India and twenty eight percent scientists disagreed. In case of Academicians, forty eight percent agreed and fifty two percent disagreed and in case of NGOs seventy four number of respondent agreed but twenty six of them did not agree with the statement. Out of three hundred respondents, sixty five percent agreed to the positive effect of the patent in Indian agriculture on food security system of India whereas thirty five percent did not agree to the given statement. In order to find out the result chi-square test isapplied.

The result is significant ($\chi^2 = 18.3233$, d,f.=2,P =0.0000105), as the null hypothesis rejected at five percent level of significance. So Patent in Indian Agriculture will boost up the food security system inIndia.

Conclusion

The introduction of IPR in agricultural sector brought a vast change in food production. India is a country having a population of around one thirty cores and it is very much difficult to feed such a huge population with a limited land resources and traditional way of farming. In this critical juncture India has to adopt Agricultural Biotechnology and GM crops not only to increase the capacity of food production but also to reduce the cost of food products by which deprived and downtrodden section of society can purchase the food products. There has been a countrywide debate involving policymakers, scientists, NGOs and other stakeholders on the issue of Genetically modified crops and patent in agriculture. But the fears of people are not scientifically proved and biased. This study clearly outlines the necessity of GM crops in Indian context for food security.

Excessive use of fertilizers, pesticides and herbicides not only create land pollution but also increases expenditure on agricultural production. The continuous suicide of farmers in different states indicates that poor farmers are unable to bear the heavy expenditure of agriculture. Therefore, they are trapped by money lenders and it creates an alarming situation for India. In this situation Govt. of India should emphasize the IPR in agriculture which will promote transfer of technology. About GM crops many myths have been cleared. GM foods will be cheaper having better nutritional qualities. It will reduce the cost of production of crops which will facilitate the food security. Though there are certain demerits of GM crops, its positive qualities outweigh negative qualities. It may be suggested that Govt. of India should carry forward it policies with utmost precaution andfield testing.

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