AGRO-BIOTECHNOLOGY : A TOOL FOR REDUCING HUNGER AND POVERTY

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Abstract

World poverty and hunger is a major concern of public health. Several methods are being adopted to overcome this problem. Science Engineering & Technology have been able to make several major contributions to it. But one discipline, though equally profitable in form of results has been side tracked so far. Agricultural biotechnology can offer various solutions which can help with eradicating the world major classified problem ,i.e Poverty , of not only hunger and poverty but also malnutrition and undernourishment. Thus, with the growing population, there is a need to further develop in this discipline with extensive research .

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Introduction

Poverty is a multifold term involving social, political and economic elements. It is general shortage, or the state of someone who does not have a particular quantity of material possessions or financial statements.Poverty can be further of two types:

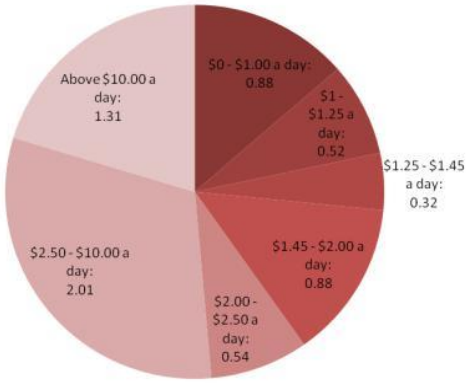
1) Absolute poverty or destitution is said to be the absence of means necessary to meet basic requirements such as food, shelter, land and clothing. Absolute poverty refers to a set standards which is consistent over time and between countries. Initially introduced in the year 1990, the $1.00 a day poverty line calculated the absolute poverty by the levels of the poorest countries of the world. The World Bank changed the international poverty line to $1.25 per day in 2008. In October 2015, the World Bank changed it to $1.90 a day.
2) Relative poverty takes into consideration an individual's economic and social status compared to the rest of society. Relative poverty views poverty as dependent on social context and socially defined, hence relative poverty is a measure of income inequality in a society. Usually, relative poverty can be measured as the percentage of the population with income less than some fixed proportion of median income.

One of the major characteristics of poverty is hunger or starvation. Though, poverty and starvation are misinterpreted often, poverty is not the sole reason of Starvation and starvation is not the sole symptom of Poverty. It can be said the poverty causes hunger as the lack of financial support.Possessions may hinder with the capability of an individual to avail meals. Poverty is majorly caused due to the extreme rate of urbanization. People move to cities in search of jobs and better standard of living. A low earning rural farmer streams into the city to find work and a better income by selling his farmland for some industrial process. This depletes very efficient and highly productive rural agriculture, thus reducing the probable maximal agricultural food or crop production. [1]

Food Insecurity a Global Challenge

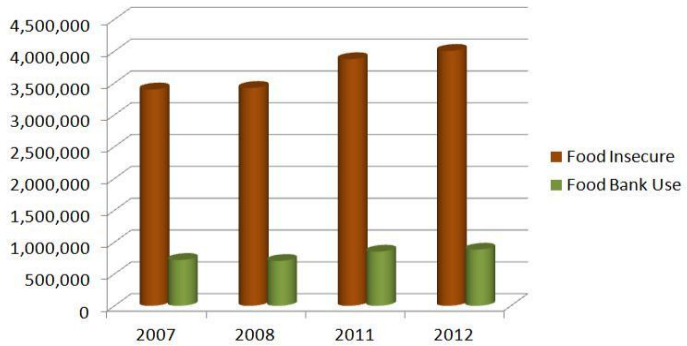
Food security, on the other hand, is the major concern. It exists when at all times; all the people have economical and physical availability to ample, safe and nutritional food to fulfill their dietary needs and food preferences for a healthy and active life. It is about a community's ability to provide for its own food requirements. This can be possible if the food is produced within the community by its members, or the other way is if the community has the ability to afford its members to buy food from outside the community's area.The ability of a community to produce food within itself requires a level of skill and natural resources[2]. If either of these requirements are not accomplished, and buying food from outside cannot be afforded by the community, this causes a reduction in the level of food security and thus lead to hunger and starvation. Food security is not about having latest technology or techniques and higher yields rather it is, essentially, a representation and comparison of the socio-economic inequalities that are present in our societies and that the existing problems causing fluctuations in food security are democracy, basis of national economies and legal land rights.[3]

Number of people (in billions) living at different poverty levels, 2005



Source: World Bank Development Indicators 2008

Number of people living in food-insecure households vs. number reported to be helped by food banks in March of respective year.



Data Sources: Statistics Canada, Canadian Community Health Survey (CCHS), 2007, 2008, 2011 and 2012, and Food Banks Canada, HungerCount, 2007, 2008, 2011 and 2012.

The major issue is that the world hunger is not because of less amount of food production, it is rather due to the problems in the distribution of the food produced. As of now, there is enough food produced in the world to feed all its current population. Still, there is about 15% of the world's population that is undernourished. Any technique, and technology may increase the quantity of yield of food produced but it won't be able to solve the problem of unequal distribution of the food produced to the population.[4]

This is when the idea comes up that the world's poverty and hunger is not just because of lack of technology. Many different demographic (e.g. increase in the size of the population and the level of urbanization), social (Urbanized infrastructure, literacy rates), economic (e.g. changes in GDP), environmental (e.g. destruction of biodiversity and land, and political (e.g. war, economic rejections) factors may affect the extent to which particular groups of population are susceptible to malnutrition, hunger and poverty.[5]

Results and Statistics

The world's population is currently 7.6 billion as of 2017, and it is increasing at a rapid rate. It is expected to reach 9-9.5 billion by 2030.[6]

Poverty statistical analysis:

1. Hunger and malnutrition is a direct repercussion of acute poverty.
2. There are about 230 million people who lack access to safe drinking water.
3. 100 million children survive and earn on the streets.
4. Due to the effect of urbanization, poverty levels in urban areas will soon beat the rural numbers.
5. About 300 million people in Asia, 150 million people in Africa and Latin America each, live in urban areas below the internationally defined poverty line.

Hunger statistical analysis:

1. About every sixth person has no access to proper food, in the developing world.
2. 830 million people in the world are suffering from hunger and malnutrition.
3. 80 million children below the age of 4 years of age are suffering from various disorders due to malnourished.
4. The undernourished population survive on 1,800 calories per day or less, rather than the basic requirement of 2000 calories per adult per day.
5. 70% of the poor people in the world reside in the rural areas.
6. Poverty, is generally a rural aspect, which is inching into urban lifestyle.
7. According to studies, about 2.8 billion people survive on a bare minimum of US$ 2 per day.
8. Of the 1.3 billion people in South Asia about 800 million try to live on less than US$ 1 per day.

Current Scenario as of 2017-2018 (Review only)

The major impact on hunger rate and starvation was made by the Green Revolution. It caused a great increase in the crop production in developing countries achieved by the usage of artificial fertilizers, insecticides, pesticides, and high- yield crop varieties. It was a technology transfer initiative which occurred between 1930s and the late 1960's. These initiatives brought about a production of newer, better, high yielding varieties of cereals, mainly wheat and rice along with agro-chemicals and chemical fertilizers with controlled water supply for irrigation purposes. They involved newer methods of cultivation to bring about better production. These initiatives were able to override the more traditional approaches to farming and thus were widely accepted. Cereal production almost doubled up in most developing countries between the years 1961-1985.[7] The world population has almost grown by 4 billion since the time of green revolution, and thus it is believed that without the Green Revolution, there would have been greater malnutrition, starvation and famine. India, a developing nation itself, witnessed the rise in the annual production of wheat from 10 million tons in 1960 to 73 million tons in 2006. The world grain production saw an increase of about 160%, while the Green Revolution transformed agriculture practices around the globe. Though Green Revolution was able to improve the agricultural production in some regions of the world, there is still room for improvement.[8] Thus, continuous development of newer and better ways to improve the techniques already used is required.After fifty years of modernization and techniques of Green Revolution being used, the world agricultural production is more than enough to feed the current population adequately. Cereal production of 2 billion tons or 330 kg of grain per caput/year and about 3600 calories per caput/day could cover a large extent of energy needs of the

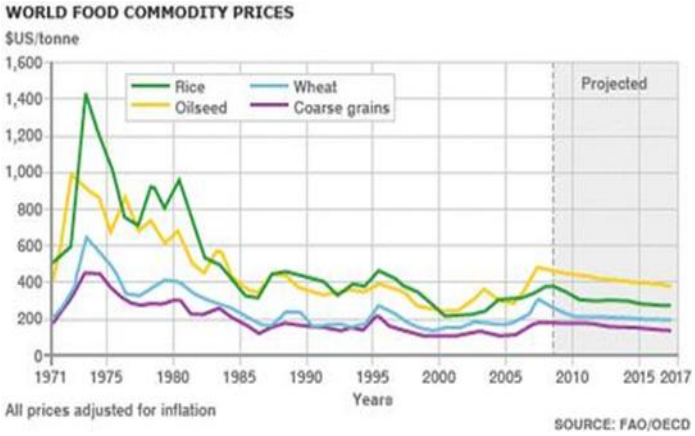
whole population, if it were well distributed. However, this availability varies greatly from country to country. Most of it is utilized in animal feed, besides each country's access to the food or their means of production are uneven among households. Thus, in many countries large portions of the population do not have enough food. And the large majority of 830 million people are severely undernourished.

Another major issue is that the agricultural biotechnology or agro-biotech has been driven majorly by the private sector for farmers in the developed nations. Products developed so far have not been targeted to the poorer farmers in the developing nations with only a few exceptions. This gap would only be covered if the techniques that increase the efficiency and quality of food production are able to provide tools to remove the inequalities in the world.[9]

Genetically Modified crops are engineered such that thy produce more yield on less land. This results in an increase in productivity and thus offering the developing nations a way of sustaining themselves and reducing the levels of worldwide hunger. 90% of the world's 13.3 million "agro-biotech crop farmers" belong to the developing nations. India, with 7.6 million hectares, is at the fourth position among the 14 "mega-biotech crop" countries. There are about 5 million farmers in India who are planting about 7.6 million hectares of "Bt Cotton" which is genetically modified in such a way that it protects itself from a species of caterpillars specially Bollworm without requiring external pesticide. This great change in the plantation of "Bt Cotton" has been made possible because of the thirty nine percent decrease in insecticide use, increase in profits by $250 per hectare, and thirty one percent increase in its yield.[10]

Economic Tripple Challenege

The problem is hunger but there has to be a solution. And to find that solution, there has to be clear picture of what comprises of that problem. This is when the triple challenge comes in.The first challenge is comprehending and preparing for the unparalleled levels of global population. The global population is expected to rise to nine billion by 2030. This rate of increasing population requires an increase in the food production. Since 70% of the world's population lives in the developing nations, this is where the major food availability is required [11].The second challenge is making certain that the population has access to adequate quantities of food at adequate prices at all times. This is a concern due to the unequal distribution of the global food production. Thedeveloping countries having the majority of population do not have majoring of food available due to low food security and difference in the socio-economic status.

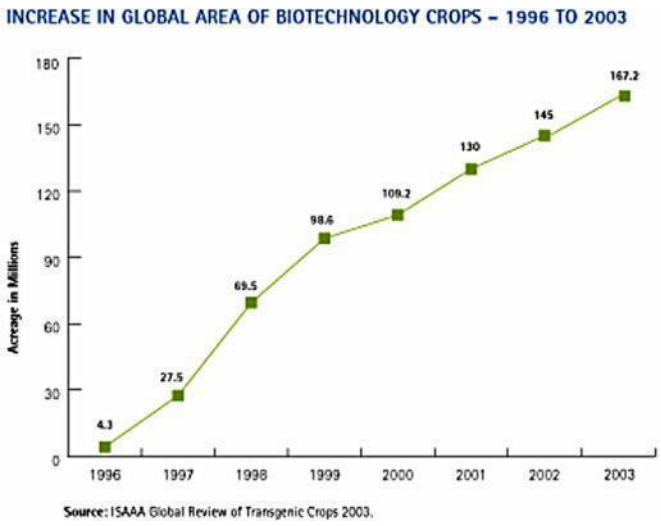


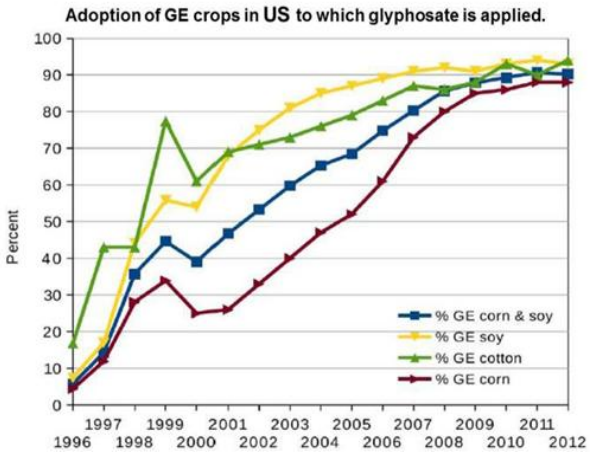
The third and the major challenge is production of food in such a way that it does not destroy the natural resources, on which we depend. Processes like single crop production, cause depletion of nutrient level of soil. Multi-crop production and crop rotation are techniques which help to restore the nutrient level of soil. Due to urbanization, fertile agricultural land is being used for industrial and other uses. The only option that is considered is depletion of forest land in Africa mainly. But this causes loss of biodiversity which has major impact on the environment. Thus, this method though adopted is still avoided as much as possible. This causes reduction in the quantity of agricultural product and food thus increasing poverty and hunger. There comes a need for crops which have the ability to produce higher yields in small land area. Water and energy both play a very important role in our day to day life, in the same way they are very essential for agriculture. A large amount of fuels are used in irrigation and cultivation of crops, these fuels are non-renewable and thus cost a lot to the farmers. This causes a decrease in their income, and led them further into poverty. Biofuels, come up as a better choice, they are renewable, easily producible, cheap and do not harm the environment.[12]

The second and the third challenge combine together to form the challenge of sustainable food security. Further these challenges can be classified into technological and political. The requirement of developing newer, highly-productive, environmentally sustainable production systems and the requirement of policies that do not discriminate against rural areas in general and agriculture in particular.

Evnice Solution to Current Solution

Various revolutions in biological sciences have been fuelled by ground breaking work done in molecular genetics. The developments of Genetically Modified and Transgenic plants are an example. The plants have been genetically altered so as to have earlier maturity, increased transportability, improved nutritional quality, and reduction in post-harvest losses. Further, advancement in the bioinformatics and computing has made it easy to access information at universal level.[13] This has helped with transparency and better availability of scientific information and databases making development of better techniques far easier. As enormous sum of money is being invested in the biotechnological research, the expectations on it to bring forth better and more productive results have risen.These revolutions in biological sciences is expected to give way to newer, better, higher yielding crops that are resistant to scarcity of water, acidity of soil, salinization and that cause less damage to the environment. Their aim is not only on food production but also on human welfare as a whole. Newer remedies for life threatening diseases, edible vaccines for easier access to the population. Single cell proteins for feeding the cattle, so as to reduce the amount of crop used just to feed the cattle. Cleaner and biodegradable waste, hyper-accumulating plants that help to remove toxins out of soil to improve its nutritional value. And last but not the least, reducing the amount of land used for agriculture, thus expanding the forests and wild-life habitats so as to preserve the biodiversity and thus the planet earth.





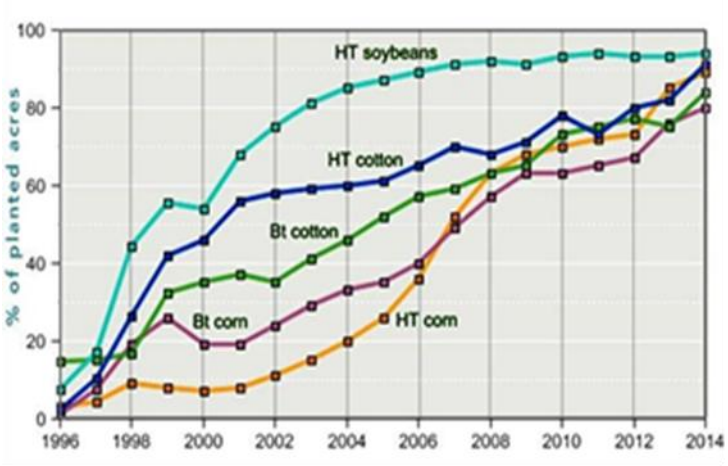
(Source: ISAAA Global Review of Transgenic Crops 2005.)

In the recent years, agro-biotech has become one of the major activities in the private industry, their main target being the developing countries, with possibilities of further expansion and development in the near future.[14] The commitment of agricultural biotechnology as a technique of advancement lies in its ability to further improve the quantity and quality of crops, plants and livestock, rapidly and adequately. How can all this be achieved is a question that comes up after knowing what needs to be done. There are two major ways we could come up with:

1. Crop improvement:It is a new genomic technique, likethe marker associated breeding. Crop improvement allows better selectivity and reduces the factor of randomness in plant breeding techniques. These approaches have been utilized to bring forward a range of qualities such as increase in resistance of crops to pests and diseases and submergence tolerance in rice. So far success has been seen in the development of disease-resistant cassava, which is now distributed throughout Rwanda, the Democratic Republic of Congo, Uganda and Burundi. In the near future, agro-biotech techniques have great potential as being one of the major key technologies that offer solutions, thus rapidlyincreasing our potential in developing various varieties of crops with resistance to scarcity of water [11],temperature, salinity, pests and diseases, making sure that the environmental and food safety conditions are maintained.
2. Bio-fortification: Bio-fortification in form of changes in the production and increase in the micro nutrients in crops and crop breeding techniques may become increasingly important as means to reduce malnutrition in developing countries. The World Health Organization in its studies estimated that vitamin A deficiency is the reason of causing blindness in more than half a million children every year. Genetically modified crops like rice and potato have shown increased levels of nutrients including vitamin A, zinc and iron [11]

Trump Card Of Using Agro-Biotechnology Techniques

Maintaining current crop yields, developing agricultural techniques further, storage of agricultural products, reducing the use of insecticides, pesticides and fertilizers; and livestock management are a wide range of agricultural applications which are the conceivable advantages of biotechnology. The real challenge that the global population is facing now is whether we are capable enough to actually use these numerous benefits of the field of biotechnology.[15]But what can be these potential solutions? Improvement in traditional plant breeding technologies and development of synthetic food are a very promising variant offered by biotechnology. When these are combined with other advancements in agricultural technology, it becomes a very responsible and eco-friendly method to fulfill the consumer demand for preserving the ecological balance and avoiding depletion of natural resources. When the profits from genetically Modifies crops is accessible to the financially unstable and marginal farmers, more Green Revolutions may become a reality.[16]Another possible techniques offered by biotechnology is the extraction and use of biofuels. Extraction of plant oil almost till 90% is now possible because of these biotechnological techniques. With the increasing use of the hydrocarbon resources each day, the extraction of plant oil such as biodiesel comes as a boon. This may even be able to compete the coal, gas and oil in terms of quality and price.



(Chart:- Adoption of genetically engineered crops in the united states ,1994-2014.)

Accomplished Goals so Far

Agricultural biotechnology programs have been able to make their impact with actual products and most of them still in development,. Several of these products are being used in have been established in Kenya, Burundi, China, Singapore, Costa Rica, South Africa, India, Egypt, Indonesia, Honduras, Malaysia, Jordan, Brazil, Philippines, Mexico, Colombia,Vietnam , Thailand, Cote d'Ivoire, and many others.[17]

The total area planted around the globe with transgenic crops was about 1.7 million ha in the year 1996, 11 million ha in the year 1997, about 27.8 million ha in 1998, and 39.9 million ha in 1999. The most common transgenic plants grown in the year 1998 were papaya, squash, potato, rapeseed, cotton, maize, and soybean. The calculated profit from these transgenic plants increased globally by almost thirty times between

1995 and 1999. This became the time when these plants were brought into focus and development in them furthered. This profit increased to approximately US$3 billion in the year 2000, about US$8 billion in the year 2005, and about US$25 billion in the year 2010. It is projected to increase up to US$60 billion by 2030.Early products of agro-biotech had crop protection as their main focus. Plants with herbicide tolerant varieties came highly in use, these were able to control weed growth by hybridizing herbicidal genes in them, and this reduces the use of herbicide to a large extent. Increased pest resistances in plants, have genes in them that produce chemicals that are lethal to the target insect pests. This has caused a decrease in the use of pesticide in areas using this crop, Bt Cotton is an example of such a crop. Bacillus thuringiensis, is a common soil bacterium that produces a protein toxin that kills certain insects. The toxin is a crystal (Cry) protein produced by the cry gene. Biotechnologists have been able to isolate the gene responsible for the production of toxin and introduce it into a number of crop plants using Agrobacterium Ti plasmid mediated transformation. The new genetically modified Bt Cotton is resistant to Bollworm complex (specific caterpillar pests). Tomatoes with Bt gene are completely protected from an attack of caterpillars. Similarly, GM tobacco with Bt gene is protected from hornworms. This protection of crops from pests allows higher yield thus leading to more production of food.Golden Rice, is an example of transgenic plant. It is found that approximately 140 million children which belong to the low-income groups in about 118 countries, mainly in the regions of South-East Asia and Africa, have a deficiency in Vitamin A. This situation has become a great public health concern. WHO reported that an estimation of about 250,000 to 500,000 children became blind every year due to deficiency in Vitamin A, and about 50% of them die within a year of losing eyesight. Golden Rice, a transgenic plant which contains 3 new genes – one from a bacterium and two from Daffodil, created by scientists in Switzerland and Germany. This transgenic plant helps in the production of pro-vitamin A. This rice, if distributed properly can help with the cases of malnutrition. Golden Rice is just one of the many products of biotechnology which can make great contributions to the society if used responsibly This plant shows how agro-biotech can contribute in combating hunger and malnutrition.[18]

Except Golden Rice various other crops like wheat, tomato, bananas, potato and Brassica napus are several crops whose transgenic variety has been prepared and tested. The transgenic potato variety showed an increase in the starch content by 20-40%. The transgenic variety of banana contains in their genetic material a portion of “enterotoxin” gene of E. coli. These bananas act as edible medicine to protect children from Diarrhoea. The transgenic variety of Brassica allowed the chemical synthesis of “hirudin” (a protein that prevents blood clotting), this was then extracted from the seeds and purified to be used in medicine.[19]

Future Scope A lot of research and work has been done and is still ongoing, but their practice in the actual world has been delayed so far. To bring these techniques and products to the actual agricultural field is the need of the hour. Though there are several ethical and social stigmas attached to the use of biotechnology, but the advantages outweigh these stigmas and fears. The artificially created products provide better output than the wild or natural variety of the crop and thus to combat with the growing population and hunger rate, they need to be adopted. These techniques have the capability to give fast profits, not only in monetary terms but also on the socio-economic front.[20]

Conclusion

The challenge is clear. The world must produce 40% more food, with the limited amount of water & land, and using less energy, fertilizer and pesticide by 2030 at the same time as bringing down the level of greenhouse gases (CFCs, oxides of Nitrogen and Sulphur) emitted globally, and while coping with the impact of climate changes that cannot be avoided. To accomplish this, we must maximize both the use of those technologies already developed and generate and explore new scientific discoveries. What we require is a new and greener revolution, a revolution with science and technology at its heart [1].The food supply present in the world is abundant. The quantity of production of cereals and other crops is sufficient to provide about 4 pounds of food to every person every day at the minimum. It is highly argued that solving the problem of world hunger requires not only agro-biotechnological solutions, but also the political approaches. Biotechnology should not be looked upon as a hypothetical, unproven field or approach, rather the full body research which offers solution to ending world hunger and raising the food quality should be highlighted. Biotechnology can provide solutions that are ot only technological in nature, rather they are embedded into the roots of the basics of socio-economic realities. Though, biotechnology can help reduce hunger and malnutrition, but the current focus should be on the political and social facets, which are keeping the people hungry and poor as there is no technology which can eliminate those concerns. Biotechnology has techniques that can help solve the problem of world hunger but Agricultural biotechnology cannot be a magic wand, that can erase hunger and poverty in one go or without the help of other facets of this problem. There is only one thing for sure, and that is all the evidence made available so far suggests that it can be one of the major effective weapons on the developmental front.

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