



Agricultural Biotechnology – An Effective Tool to Alleviate Poverty in Rural India

KEYWORDS

Agricultural biotechnology, rural poverty, transgenic plants, biosafety and environmental safety.

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ABSTRACT

Worldwide 800 million people go to bed daily on empty stomach and there are 40,000 hunger related deaths every day. With great efforts by implementing various anti poverty schemes, India has managed to reduce the number of poor from 55 percent in 1973 to about 27 per cent in 2004. The 2011-12 status reveals that 216.5 million people in rural areas are poor i.e., one third of the total population in India lives below the poverty line and especially they are farmers and landless wage workers living in villages. The agricultural practices followed are primitive and traditional in nature that yields less per unit area of land and water. This alarming situation calls for the adoption of alternate technologies that would be economically viable, environmentally friendly and culturally acceptable. Agricultural biotechnology is the one option could give solution to these problems. Micro propagation through tissue culture, development of genotypes resistant to biotic and abiotic stresses, marker assisted selection strategies, delaying the senescence of perishables, development of vaccines against animal diseases etc. are potential areas of agricultural biotechnology. Transgenic Bt cotton, transgenic rice, mustard, rapeseed, fish and animal are the potential outcomes of biotechnology that could help the farmers. The challenges in development of new technology are less investment in biotech research by public sector, monopoly proprietary nature of technologies and IPR issues were discussed in this paper. Recommendations like involvement of farmers in identification of field problems, ensuring long term public sector funding, innovative mechanisms for technology dissemination, development of international norms with respect to biosafety were made to strengthen the biotechnological research and application in the field level to augment agricultural income and thereby the alleviation of rural poverty.

Introduction

As per the eleventh National Development Plan of India more than 300 million people in India are poor. With great efforts by implementing various anti poverty schemes, India has managed to reduce the number of poor from 55 percent in 1973 to about 27 per cent (326 million) in 2004. The 2011-12 status reveals that 216.5 million people in rural areas are poor i.e., one third of the total population in India lives below the poverty line and especially they are farmers and landless wage workers living in villages. Scheduled castes and tribes are the most vulnerable to rural poverty.

Rural economy mainly depends on agriculture and its allied activities viz., cattle rearing, poultry, fish rearing etc. The erratic rainfall pattern due to climate change most of the times results in crop failures and led to the farmers under debt. Extreme poverty compels many farmers to commit suicide. Rural Indian depends upon agriculture for everything. But most of farmers still rely on traditional or primitive methods of agriculture.

The heartbreaking worldwide scenario on food availability

Worldwide 800 million people go to bed daily on empty stomach and there are 40,000 hunger related deaths every day. Half of them are children. Mahatma Gandhi, the apostle of peace called hunger the greatest violence. The estimates reveals that by 2020, the number of undernourished will surpass one billion. Malnutrition plays a significant role in half of the nearly 12 million deaths each year of children under five in developing countries. In addition to the lack of food,

micronutrient deficiencies especially Vitamin A, Iodine and iron are widespread among the children and pregnant women. By 2030, the world's population is expected to grow to 8.1 billion at a rate of over 75 million people per year.

Need of sound technologies

In developing countries about 650 million of the people live in rural areas where the agriculture is the main economic activity. The agricultural practices followed are primitive and traditional in nature that yields less per unit area of land and other resources like water. The industrialization, shrinking of land holdings, depletion of water resources, shortage of labour force in niche areas of agriculture and non-adoption of scientific practices and sound technologies in agriculture and allied fields led to poor yield from agriculture. The vagaries of monsoon and market fluctuation add to worsen the situation. This alarming situation calls for the adoption of alternate technologies that would be economically viable, environmentally friendly and culturally acceptable. The one such a technology is biotechnology and more precisely we can call it as Agricultural Biotechnology.

Agricultural Biotechnology

Biotechnology is defined as any technological application that uses biological systems, living organisms or derivatives thereof to make or modify products or processes for specific uses. Agricultural biotechnology is a collection of scientific techniques, including genetic engineering, that are used to modify and improve plants, animals and microorganism for

human benefit. It is not a substitute for conventional plant and animal breeding but can be powerful compliment that could contribute sustainable agriculture and rural development, with particular concerns for biosafety and biodiversity. Agricultural biotechnology has major potential for facilitating and promoting sustainable agriculture and thereby rural development. They could also generate environmental benefits, especially where renewable genetic inputs can be effectively used to substitute for dependency on externally provided agro chemical inputs. Biotechnology should be considered as one tool in a wide array of technological option, to be applied where it is needed and where it offers the best available options for solving specific problems.

Potential areas of biotechnology application

Agricultural biotechnologies have major potential for facilitating and promoting sustainable agriculture and rural development. The broad areas in which biotechnology can be utilized effectively are summarized below.

- Micro propagation through plant tissue culture technology to generate disease free plantlets and also to revive or mass multiply the vanished or endangered crop species or varieties.
- Development of genotypes with resistance to biotic stresses like pest and diseases
- Development of plant genotypes resistant or tolerant to abiotic stresses viz., high temperature, drought, low temperature, salt and other toxic elements. Use of Pink Pigmented Facultative Methylootrophs (PPFM) like *Methylobacterium* and *Bacillus subtilis* could save the crops from drought (Barnawal et al., 2013).
- Generation of higher nutrients like pro-vitamin A, iron, essential amino acids in staple crops like rice and wheat
- Development of biofertilizers, biopesticides, biofungicides etc. to reduce the chemical application in agriculture to improve soil fertility and contain pest and diseases. The use of Effective Microorganism (EM) in agriculture can bring variety of benefits in plant growth and development besides beneficial to animals and birds (Alagukannan and Ashokkumar, 2015).
- Marker assisted selection strategies for improving agronomic traits in animal and plant varieties for increased yield
- Delaying the senescence of perishables like fruits and vegetables to extent their shelf life
- Deriving vaccines against animal and poultry diseases
- Crop improvement towards better palatability and digestibility for animals and humans

Biotechnology in rural areas means that biotechnology has been extended or is being applied in rural areas and includes traditional biological technologies as well as gene engineering technology. Biotechnology helps agriculture to become a most promising and prospective industry for application. Transgenic Bt cotton, transgenic rice, transgenic mustard, transgenic rapeseed, transgenic fish and animals are the potential outcomes of agricultural biotechnology. Biotechnology can help farmers produce more nutritious crops, while sustaining the land's ability to support sustained farming. By developing crops that more efficiently absorb nutrients from the soil,

biotechnology can help farmers to reduce the need for application of costly inputs such as fertilizers. Hence, biotechnology holds tremendous scope for the developing countries like India. The use of high yielding, pest and disease resistant crops and animals with adverse condition resistance would have a direct bearing on improved food security, poverty alleviation and environmental conservation.

Risks in use of Biotechnology

Assessing the impacts of biotechnology on human and animal health and also on environment is crucial factor. Caution must be exercised in order to reduce the risk of transferring toxins from one life form to another. Any outcome of the technology that upsets ecosystem balance is undesirable. For instance Bt cotton was resistant to primary pest of cotton (boll worm) but the secondary pests like jassids become the serious menace and of economic importance of late. The scientific consensus emerging from the vast range of biosafety studies of transgenic plants are that each case should be evaluated on its own benefits and ill effects. Though the potential is there by use of biotechnology, but serious questions remain concerning the correct strategies for realizing the potential given the region's human, financial and industrial constraints. There have been concerns and controversy about the environmental and human health risks from the early stages of development of biotechnology and continuing till now. It should bear in mind that in a biological sense, the inter-species genetic modifications in crops and animals is not new and it is naturally occurring. Many conventionally bred crops are found to contain genes or segments of chromosomes from totally different crop species. The phenomenon which are often cited as unique biosafety issues for genetically modified crops actually also occur in conventional plant breeding and also in nature among the wild and cultivated species.

Challenges in accessing the benefits of biotechnology

Agricultural biotechnology has major potential for facilitating and promoting sustainable agriculture and rural development. However the power of modern biotechnologies to generate useful genotypes has not been harnessed to poorer farmers. The Consultative Group on International Agricultural Research (CGIAR) reviewed and revealed that the majority of developing countries have limited access to the tools to apply more sophisticated biotechnology research. The barriers to such inaccess are financial, scientific and social factors besides lack of infrastructural resources. The fact upon everyone should agree that biotechnology research has not closely integrated with the problems and constraints faced by small and poor farmers. Biotechnology needs to be focused on some problems within sustainable agriculture and rural development that historically have not been effectively tackled by conventional technologies.

The research and development in biotechnology areas is limited in public sector (Sharma et al., 2010) whereas the private sector shows its strength in developing new technologies or crop varieties. Hence, they become monopoly for their produce and the cost of those produce, for example seeds of Bt cotton are high as fixed by the private companies. These pose the challenge to the small farmers to buy and use such a seeds.

The myth or negative belief developed among the consumers, for instance, Bt Brinjal also have the impact on widespread of biotechnology. Biosafety considerations and consumer acceptance becomes the major challenge. The other potential challenges in development of new technology or product also includes less investment in biotech research by public sector, monopoly proprietary nature of new technologies and IPR issues as they cause research management to grow in

complexity and cost.

Recommendations to reap the multi benefits of biotechnology
The choice of biotechnology should be driven by the determination of local needs. The technologies to be evolved should cater the needs of poor famers in terms of adorability to use it and market the produce at reasonable price without harming the environment. The following are the recommendations to research systems and policy makers to expand the use of biotechnology towards sustainable agriculture and thereby poverty alleviation in rural areas is possible.

- Any research on biotechnology should have consider the affordability level of small and marginal farmers
- Long-term public sector funding should be ensured to strengthen the infrastructural and man power requirements to accomplish the task of evolving new technologies
- Governments will have to consider the innovative mechanism for the transfer of biotechnologies among the clients – the farmers. In India the Krishi Vigyan Kendra (Farm Science Centre) functioning under Indian Council of Agricultural Research, NewDelhi may be considered as the window to deliver the needed technologies at right time
- The barriers like negative belief on biotechnologies among the common people and environmentalists should be cleared off by proper awareness creation by mass media. The necessity, benefits and impacts of biotechnology should be inculcated in their mind
- The monopoly proprietary nature of biotechnological inputs must be broken in the chain and more public sector institutions should come forward to take up the research considering the concerns and problems of small farmers. The funds available under Corporate Social Responsibility (CSR) may be utilized for this purpose
- The participation of poorer farmers and local level stake holders must be ensured before commencing the particular research and formulation of policies in this regard.
- The development of international norms with respect to biosafety in use of agricultural biotechnology is essential
- The risk, if any due to the adoption of any practice evolved by biotechnology should be properly assessed before it is being adopted on al large scale

Conclusion

From the forgoing discussion it could be concluded that, agricultural biotechnology have major potential for facilitating and promoting sustainable agriculture and rural development. But the technologies are to be harnessed to suites to the poorer farmers to afford its high cost of inputs. Necessary mechanism have to be developed to assess the socio-economic impact, its impact on environment on long run and consumer acceptance before bringing any biotechnology based product or technology into mainstream of its utilization. Suitable policies are to be framed to avoid the monopoly proprietary nature of biotechnologies for that the public sector has to work on long run to develop the technologies. Even with all of these constraints agricultural biotechnologies indeed serves as the tool to promote sustainable agriculture and thereby alleviate poverty in rural areas where the farming community lives.

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