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SUSTAINABLE AGRICULTURAL PRODUCTION IN INDIA

Dr.R.L. POONGUZHALI

Assistant Professor,

Department of Economics,

ADM College for Women (A), Nagapattinam.

Abstract

Biotechnologies have played an important role in the development of food products over many centuries. In recent years the “modern biotechnologies” of molecular biology and gene technologies have gained a significant role in the cereals sector, sustainable development goals that embody ecological, social, and economic requirements. In addition, biotechnology should be considered one tool in a larger portfolio of technological options, to be applied where it is needed and where it offers the best available option for solving specific problems. Biotechnology contributes a significant role to fulfill the desired nutritional requirements of the blasting population of the world.

Introduction

By 2030, the world's population is expected to grow to 8.1 billion at a rate of over 75 million people per year. Almost all of the population increases will occur in developing countries (FAO 2000) that can ill-afford additional population pressures. Based on a population-increase-only projection with per capita consumption remaining constant, world cereal production must rise from approximately 1.92 billion tons in 1990 to 2.88 billion in 2030 to match the demand. Although the number of undernourished people in developing countries is expected to decrease; the global food-system situation will continue to be unacceptable.

However, Even if we resolve the issue of distribution in the short run, the future growth in food demand will required increases in productivity from your decreasing stock of arable land. The challenge, therefore, is not only to feed more people, but to do so with less available arable land, fewer nonrenewable resources, less water, and fewer people engage in primary agriculture. A number of significant trends in both the agricultural production and food processing integration of these sectors. The past decade has seen a continuing move away from an historical commodity focus towards an emphasis on value-adding. At the same time the integration between agricultural production and food processing has been driven by a variety of competitive forces leading to what is now termed the “Agri- Food Value Added Chain Differentiating products. The emergence of modern biotechnology has invoked a major global controversy over the future of world Agriculture. The debates surrounding this controversy have often reflected the interests of developed countries and paid little attention to the needs of developing countries, especially those needs related to food requirements of low-income populations.

Agriculture is a way of life for more than sixty per cent of India's population. The cultivation of land not only sustains their livelihood but also provides a social milieu for their day-to-day living. No wonder the hopes, despairs, joys and sorrows of rural communities are woven around what the land provides. Around 35 years ago, agricultural production in India got a major boost with the introduction of dwarf varieties of wheat and rice. The introduction of these varieties led to a dramatic increase in the yields of two crops. Some productivity enhancement came through the use of hybrids in corn, sorghum and millet although the area under cultivation of these crops has steadily decreased in the last decade. In the last 10 years the yields of rice and wheat have also plateaued out. The productive agricultural areas in the north, due to continuous rice-wheat cultivation are encountering serious problems of sub-soil water depletion, deficiency of micronutrients in the soil and increase in the use of pesticides, fungicides and herbicides to control pests, pathogens and persistent weeds. Agricultural Production is becoming more and more dependent on agrochemicals, thereby increasing input costs and causing significant damage to the environment and human health.

Both farmers and consumers are at the receiving end - farmers by exposure to agrochemicals and consumers due to residues of agrochemicals in the consumed food.

What is Biotechnology

Broadly speaking, biotechnology is any technique that uses living organisms or substances from these organisms to make or modify a product for a practical purpose (box 2). Biotechnology can be applied to all classes of organism - from viruses and bacteria to plants and animals - and it is becoming a major feature of modern medicine, agricultural and industry. Modern agricultural biotechnology includes a range of tools that scientists employ to understand and manipulate the genetic make-up of organisms for use in the production or processing of agricultural products.

Some applications of biotechnology, such as fermentation and brewing, have been used for millennia. Other applications are newer but also well established. For example, micro-organisms have been used for decades as living factories for the production of life-saving antibiotics including penicillin, from the fungus *Penicillium*, and streptomycin from the bacterium *Streptomyces*. Modern detergents rely on enzymes produced via biotechnology, hard cheese production largely relies on rennet produced by biotech yeast and human insulin for diabetics is now produced using biotechnology.

Biotechnology is being used to address problems in all areas of agricultural production and processing. This includes plant breeding to raise and stabilize yields; to improve resistance to pests, diseases and abiotic stresses such as drought and cold; and to enhance the nutritional content of foods. Biotechnology is being used to develop low-cost disease-free planting materials for crops such as cassava, banana and potato and is creating new tools for the diagnosis and treatment of plant and animal diseases and for the measurement and conservation of genetic resources. Biotechnology is being used to speed up breeding programmes for plants, livestock and fish and to extend the range of traits that can be addressed. Animal feeds and feeding practices are being changed by biotechnology to improve animal nutrition and to reduce environmental waste. Biotechnology is used in disease diagnostics and for the production of vaccines against animal diseases.

Biotechnology is the product of interaction between science of biology and technology. According to British Biotechnologist - It is the application of biological organisms, system or biotechnology and Indian Economy Dr. Subhransubala Mohanty process to manufacturing and service industries. Similarly, Japanese Biotechnologist defined it as A technology using biological phenomena for copying and manufacturing various kinds of useful substances. According to US National Science Foundation - it is the controlled use of biological agents such as microorganisms or cellular components for beneficial use. Thus biotechnology is an integrated

application of knowledge and technique to draw benefits from properties and capacities of microorganisms and animals and plants.

Economics of Biotechnology

Biotechnology has potentially to play a pivotal role in every sector of the economy. The contribution of biotechnology in agricultural sector is not comparable. The industrial sector, trade and business can flourish to any extent only by judicious use of biotechnology. In this context, the contribution of biotechnology to different sector may be analysed as follows.

Biotech and Agri-Sector

Agriculture is the backbone and the sheet anchor of Indian economy. It is also the nucleus of food supply, livelihood of majority of population and significant source of revenue and national income of the country. In Spite of its formidable ole, it still remains outside the scope of economics reforms and faces a lot of challenges in the days of globalisation and liberalisation. Indian agricultural has been witnessing slow average annual growth rate even in the reform period in comparison to international standard due to (i) feudal character of production, (ii) dualism in labour market, (iii) orthodox farming technique, (iv) sub-division and fragmentation of landholding, (v) cropping pattern, (vi) instability and fluctuations, (vii) absence of crop rotation, (viii) agricultural indebtedness and (ix) lack of organised technique.

Role of Biotechnology

The application of technologies in cereals industries has become a critical competitive factor in the success for these industries. Technologies have played a role in the integration between the agricultural production sectors and food processing. Technologies are a vital element in the development of new value-added food products. Technology is fundamental to all businesses in today's agri-food marketplace. Technology provides the principal, often only, route to :

- Reducing cost
- Providing new business opportunities
- Aligning food products with consumer needs
- Facilitating and supporting strategic change.

Biotechnologies have played an important role in the development of food products over many centuries. In recent years the “modern biotechnology” of molecular biology and gene technologies have gained a significant role in a cereals sector. Sustainable development goals that embody ecological, social, and economic requirements. In addition, biotechnology should be considered to be considered one tool in a lot a portfolio of technological options, to be applied to where it is needed and where it offers the best available option for solving specific problems. Another potential area for Biotechnology application is the development of livestock that installer into many tropical diseases. Modern methods, such as genomics, could be applied in this area without requiring transgenesis. Also related to agriculture production is the significance of revegetation in marginal areas. Investment in fast-growing plants could help facilitate ecological restoration in many denuded regions of the world. Such research could also add to fodder available in these countries.

Agricultural & Allied Sector GDP

Period	Total GDP	Agricultural & Allied Sector GDP
2007-08	9.3	5.8
2008-09	6.7	0.1
2009-10	8.6	0.8
2010-11	8.9	8.6
2011-12	6.7	5.0
2012-13	4.5	1.4
2013-14	4.7	4.7
2014-15	4.1	8.24
2015-16	8.2	8.24
2016-17	7.1	17.32
2017-18	7.2	17.76
2018-19	7.21	16.02
2019-20	4.18	17.8

Source : Department of agriculture and cooperation, Ministry of Agriculture, Govt. of India, New Delhi 2015.

There has been a continuous decline in the share of Agricultural and Allied Sector in the GDP from 14.6% in 2010-11 to 13.9% in 2013-14 at 2004-05 prices. Falling share of Agriculture and Allied Sectors in GDP is an expected outcome in a fast growing and structurally changing economy. Growth (over the previous year) in the total GDP and that in the GDP of Agriculture and Allied Sector at 2004-05 prices is given below :

Area, production and yield of major Crops

Crops	Area (Lakhs hecat).		
	11-12	12-13	13-14
Rice	440.06	427.54	439.49
Wheat	298.65	300.03	311.88
Coarse Cereals	264.22	247.62	256.73
Pulses	244.62	232.57	252.27
Foodgrains	1247.55	1207.76	1260.37
Oilseeds	263.08	264.84	285.25
Sugarcane	50.38	49.99	50.12
Jute & Mesta	9.05	8.63	8.51
Cotton	121.78	119.77	117.27

Production (Million tones)		
11-12	12-13	13-14
105.30	106.24	106.54
94.88	93.51	95.91
42.01	40.04	43.05
17.09	18.34	19.27
259.29	257.13	264.77
29.80	30.94	32.88
361.04	341.20	350.02
11.40	10.93	11.58
35.20		

Yield (KG/ hec.)		
11-12	12-13	13-14
2393	2462	2424
3177	3177	3075
1590	1617	1677
699	789	764
2078	2129	2101
1133	1168	1153
71668	68254	69839
2268	2281	2449

Source : Department of agriculture and cooperation, Ministry of agriculture, Govt. of India, New Delhi 2015.

Kharif Production in 2013-14 and 2014-2015

Crop	2013-14 (4th Advance Estimate)	2014-15 (1st Advance Estimate)	Absolute Difference	Percentage Increase/decrease
Foodgrains	129.24	120.27	-8.97	-6.94
Oilseeds	22.41	19.66	-2.75	-12.27
Sugarcane	350.02	342.79	-7.23	-2.07
Cotton	36.59	34.62	-1.97	-5.38

Production in million bales of 170 kg each.

Source : Directorate of Economic & Statistics, Department of Agriculture & Cooperation.

Crop wise area sown production and yield during kharif 2014 vis-a-vis Kharif - 2013 (Lakh Hectares)

Crop	Area Sown (Kharif)		Increase/decrease over last year
	2014	2013	
Major cereals crops	-	-	-
Paddy/Rice	380.00	376.41	3.59
Coarse Cereals	182.34	196.05	-13.71
Pulses	102.34	109.08	-6.74
Total foodgrains	664.68	681.54	-16.86
Oilseeds	178.49	194.91	-16.42
Other crops	-	-	-
Cotton	126.55	114.37	-12.18
Sugarcane	48.74	50.32	-1.58
Jute	8.15	8.34	-0.19

As per 4th Advance Estimates for 2013-14, total production of rice in the country is estimated at 106.54 million tonnes which is a new record, higher by 1.30 million tonnes than the production of rice during 2012-13. Production of wheat estimated at record level of 95.91 million tonnes is also higher than production of 93.51 million tonnes during 2012-13. The production of Coarse Cereals is estimated at 43.05 million tonnes which is also higher than the production of Coarse Cereals during 2012-13. Total food grains production during 2013-14 estimated at 264.77 million tonnes is also a record. It is higher by 7.64 million tonnes than the production of 257.13 million tonnes of food grains achieved during 2012-13. Total production of pulses and oilseeds estimated at record levels of 19.27 million tonnes and 32.88 million tonnes respectively are higher by 0.93 million tonnes and 1.94 million tonnes than their production levels during 2012-13. 1.7 Production of sugarcane during 2013-14 estimated at 350.02 million tonnes is higher by 8.82 million tonnes than its production of 341.20 million tonnes during 2012-13. Production of cotton estimated at 36.59 million bales (of 170 kg each) is also a new record and higher by 2.37 million bales than its production of 34.22 million bales during 2012-13. Production of jute & mesta estimated at 11.58 million bales (of 180 kg each) is higher by 0.65 million bales than its production of 10.93 million bales during 2012-13.

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