

Determinants of Public Perception on Biotechnological Innovations

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Abstract

Biotechnology is one of the key technologies which would resolve present burning problems like climate change, pollution, malnutrition, drought and salinity and lead to sustainable development. Biotechnology has become a complex technology with its wide scope for generating multiple innovations across various industries. Unfortunately there are some apprehensions about biotechnological innovations like r-DNA technology, cloning technology etc. Due to lack of reliable information on biotechnological innovations and their utility in various industries, people are unable to perceive the merits and demerits of biotechnology. Hence it is necessary to address these issues for sustainable scientific governance. In India, the rate of generation and dissemination of inventions in biotechnology is lagging due to societal agitation on use of Bt. technology in food crops like brinjal, maize etc. and ethical concerns over GM animals. This study focuses on determinants of public perception and attitude towards biotechnological innovations.

Introduction

Technological innovations are the key elements for development of the economy in any country. There is a direct correlation between the number of technological innovations developed in the world and the world's GDP level. World GDP in 5000 BC was only 0.51 billion but it has grown to 41016.69 billion (J. Bradiford De Long) in 2000 AD.

The 20th Century witnessed the emergence of new fields of science like biotechnology, electronics, nanotechnology, management, aeronautics, etc. Biotechnology had already proved a prominent technology with a turnover of \$84.6 billion in 2010 and is expected to grow at 7 per cent CAGR to \$103 billion by 2015 (Ernst & Young, Burrill & Company). In India, the revenue from Biotechnology industry increased from Rs. 2345 crores in 2002-2003 to Rs. 17249.34 crores in 2010-2011 fiscal years. Indian Biotech industry's contribution to GDP has gradually

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increased from 0.104 per cent in 2002-2003 to 0.237 per cent in 2010-2011 (Data Book for DCH/Planning Commission of India). Though the share of Indian Biotech industry in GDP is lower than 1per cent, it is worthwhile to recognise the space for market expansion due to the increase in the size of the Biotech industry. Indian Biotech Industry is in a policy oriented struggle to introduce new innovations like Bt. Brinjal, Golden Rice, Bt. Soya, etc. Biotechnology has become the most contemplating subject due to the public unacceptance of the commercial release of Bt. Brinjal and several other biotechnological innovations.

The present research study was initiated to examine various factors which influence public perception on Biotechnological Innovations.

Literature Review

Age is considered to be a more influential factor, among other demographic factors, on technology perception as the psychological maturity to analyse pros and cons of any technology comes through experience (Grobe, et al, 1999). Education and knowledge levels of individuals have been found to be determinant factors on technology perception. Due to higher knowledge and education levels an individual can ascertain the risk and benefits of a technology (Berrier,1987, Hoban, 1996, Lulan,2006, Tianjin,2001). With higher level of knowledge on technology, people's understanding about a technology is increased (NSF-2000).

Individuals' acceptance of biotechnology is significantly related not only to cognitive variables like perception of risk and benefits associated with biotechnological innovations but their moral, religious, political, social issues and knowledge of science and technology also influence their attitude towards Biotechnology (Baker & Hhranham, 2001, Moon & Balasubramanian, 2001, Hamstra, 1995, Wan Skin & Klin, 2001). The ratio between risk and benefits of a technology itself acts as a determinant of technology perception. An international research conducted in America, Asia and Oceania reveals that almost three fifth of the population over weighs the benefits of biotechnology innovations than risks (Environics International-2000). Ineffective communication of knowledge by trusted sources is a critical current gap in biotechnology risk analysis (Scholderer et al-1998); it emphasises the need to analyse the appropriateness and efficiency of communication channels to share the knowledge among various stake holders.

Methodology

The study was carried out under the Agri Biotech Foundation¹ programme on "Pros and Cons of Biotechnology", one of the major components in the Andhra Pradesh Government funded "Rashtriya Krishi Vikas Yojana" project implemented in Andhra Pradesh. Under this project, Agri Biotech Foundation has conducted various programmes on "Pros and Cons of Biotechnology" throughout the state. For the purpose of this research study Kurnool, Kadapa, Adilabad, Warangal, Vizianagaram, Vizag, Karimnagar, and East Godavari districts were selected based on purposive sampling technique so as to represent the three regions of the state of Andhra Pradesh namely Rayalaseema, Telangana and Andhra. The sample population constituted farmers, students, and employees working in public and private sector, business people, lawyers, social workers, researchers, unorganised labour, etc.

A pre-tested structured questionnaire was administered to collect primary data from the sample population on biotechnological innovations. Out of 600 questionnaires distributed, 564 filled in questionnaires were returned, hence constituting 94 per cent response rate. After excluding incomplete questionnaires the total response rate was 440 representing 73.3 per cent of the research population. Public attitude on Biotechnological innovation was measured through the nominal scale. Respondents were asked to express their views on utility of biotechnology across five point Likert Scale and the specifications of the scale are given in Table 1.

Table 1. Specifications of the Scale to measure Public Attitude on Biotechnological Innovations

Score of the scale	Utility of Biotechnological innovations
1	No utility
2	Very low
3	Low
4	High
5	Very high

¹ Agri Biotech Foundation is an Interdisciplinary Research cum Academic institute basically working on applied research in Biotechnology and convergence of science with society through outreach programmes like public debates, public awareness campaigns, training programmes, etc.

Results and Discussion

1. Demographic Profile of Respondents

Among the respondents, there are 79.77 per cent male and 20.23 per cent female respondents in the research population. Respondents with education level up to 10th constituted a major share (43%) of the sample size, while respondents with education level upto 12th, Bachelors Degree, Post Graduate Degree and Ph.D. constituted 18 per cent, 13 per cent, 24 per cent and 2 per cent respectively. Farmers formed the major share of the respondents (54%) followed by students (36%) and teachers, government officials, researchers, retired employees, NGO representatives, journalists, labourers (11%). Respondents who were more than 26 years old formed the major share (48%) followed by middle and upper age groups with 46 per cent and 6 per cent respectively. About 32 per cent of the sample had land size up to 3 acres, while those who did not have land constituted 41 per cent of the sample. Between these two extremes, farmers who had land of 3-6 acres constituted 12 per cent and farmers who had land of more than 6 acres constituted 16 per cent of the total sample.

2. Cognitive Behavioural Analysis

Trust on Information Sources

It is evident from Table 2 that trust on information sources varied across respondents and it had an influence on the attitude towards biotechnological innovations. In this study 81 per cent of the sample expressed that the information provided by scientists is more trustworthy than from other sources like politicians, government representatives, peers or colleagues, celebrities etc. Among the respondents only 9 per cent of the sample trusted government representatives while 5 per cent trusted their colleagues/peers. Apart from these groups, a very low percentage of the public perceived that information from politicians, celebrities, business personnel, NGOs and other sources was trustworthy.

Table 2: Trust on Information Sources

S.No:	Information sources	% of sample having trust on information source	% with positive attitude on biotech innovations	% with negative attitude on biotech innovations
1.	Scientist	81	87	13
2.	Politicians	1	75	25
3.	Govt. representatives	9	55	45
4.	Peers/colleagues	5	50	50
5.	Celebrities	0.5	100	0
6.	Business personnel	1	80	20
7.	NGOs	1	60	40
8.	Other sources	1.5	100	0
	Total:	100%		

Knowledge and Acceptance of Biotechnological Innovations

The knowledge of respondents on various biotechnological innovations was measured and the results are presented in Table 3. It is evident from the table that higher the knowledge levels of farmers, students and others, greater the acceptance of biotechnological innovations than those with low knowledge level.

Table 3: Knowledge Level and Biotechnological Innovations

Category	Knowledge level	Number	Percentage	Number of people with Positive attitude	Number of people with Negative attitude	Percentage with positive attitude	Percentage with negative attitude
Farmers	Low	2	0.85	2	0	100	0
	Medium	115	49.14	87	28	75.65	24.34
	High	117	50	101	16	86.32	13.68
Students	Low	0	0	0	0	0	0
	Medium	9	5.66	6	3	66.66	33.33
	High	150	94.3	123	27	82	18
Others	Low	0	0	0	0	0	0
	Medium	10	21	8	2	80	20
	High	37	79	34	3	92	8

Communication Channels and Effectiveness of Communication Media

Communication is another major important variable in determining the societal acceptance of biotechnology innovations. Forty eight per cent of the respondents were informed through all channels of communication like print, electronic and personal mediation followed by 25 per cent of the sample population who were informed through electronic media, 20 per cent through print media and 7 per cent through personal mediation. It is evident from Table 4 that, those who were informed through print media had a more positive attitude towards Biotechnological innovations when compared to people who were informed through electronic, personal and other types of communication channels.

Table 4: Communication Channels through which Respondents were informed about Biotechnological Innovations

Type of channel	Frequency	% in total population	No. of people with positive attitude	No. of people with negative attitude	% with positive attitude on BT	% with negative attitude on BT
Print	85	20	75	10	88	12
Electronic	110	25	92	18	84	16
Personal mediation	31	7	19	12	61	39
All	172	48	172	39	81.5	18.5

Effectiveness of communication media in delivering the information on pros and cons of the technology is another important variable in determining the societal acceptance on technological innovations. The data in Table 5 reveals that, in view of public perceived value, personal mediation was the most efficient communication medium for 48 per cent of the sample population. On the other hand print, electronic and communication media were considered as efficient by 10 per cent, 39 per cent and 3 per cent respectively. Further 91 per cent of the people who perceived print medium as an efficient medium for biotechnology information dissemination had a positive attitude towards biotechnology innovations, followed by 84 per cent for electronic media and 81 per cent for personal mediation. This indicates that perception on communication medium efficiency for disseminating biotechnology information and positive attitude towards technology are not interdependent.

Table 5: Perceived Communication Channel Efficiency in disseminating Information about pros and cons of Biotechnological Innovations

Type of communication medium	Frequency	% in total population	No. of people with positive attitude	No. of people with negative attitude	% with positive attitude	% with negative attitude
Print	44	10	40	4	91	9
Electronic	170	39	143	27	84	16
Personal mediation	210	48	170	40	81	19
Other	10	2	4	6	40	60

Perceived Benefits of Biotechnology

It is seen from Table 6 that among the sample population 50 per cent perceived a single benefit with Biotechnology, followed by 35 per cent who perceived multiple benefits and the next 15 per cent of the population who perceived no benefits with Biotechnology. Thus 35 per cent of the respondents had a more positive attitude towards Biotechnological innovations when compared with people who perceived single and no benefits from Biotechnological innovations.

Table 6: Perceived Benefits of Biotechnology

No. of Benefits perceived from Biotechnology	Frequency	% in total population	No. of people with positive attitude	No. of people with negative attitude	% with positive attitude on BT	% with negative attitude on BT
0	63	15	44	19	70	30
1	221	50	182	39	82	18
>1	156	35	135	21	87	13

Potential technology validity variable was included in the study to measure the public perception on potential usage of Biotechnology for solving future problems. From Table 7 it is seen that, 46.5 per cent of the total sample perceived that Biotechnology had value in solving future problems like malnutrition, drought, natural calamities, health problems, economic imbalances, national security, pollution, etc. The majority (53.5%) of the respondents perceived that Biotechnology had no value in solving future problems. The results clearly show the relation between potential value of technology and positive attitude towards Biotechnology in Table 6.

Table 7: Perceived Potential Value of Biotechnological Innovations for solving future problems

Potential value of Biotechnology	Frequency	% in total population	No. of people with positive attitude	No. of people with negative attitude	% with positive attitude	% with negative attitude
Has value	205	46.5	178	27	87	13
No value	235	53.5	183	52	78	22

Technological threat is another variable that was studied to explore the respondents' perceptions on technological innovations in terms of threat to culture, economy, environment and human health. In Table 8 it is clear that, 13 per cent of the research sample perceived a potential threat to culture, 7 per cent perceived a potential threat to the economy, 9 per cent perceived a potential threat to the environment, 6 per cent perceived potential threat to human health and 12 per cent perceived that there was no threat due to biotechnological innovations. It is observed that as much as 53 per cent of the research sample was neutral in this matter.

Table 8: Perceived Potential Threat with Biotechnological Innovations

Potential threat to	Frequency	% in total population	No. of people with positive attitude	No. of people with negative attitude	% with positive attitude	% with negative attitude
Culture	57	13	38	19	67	33
Economy	32	7	26	6	81	19
Environment	40	9	33	7	82.5	17.5
Human health	25	6	18	7	72	28
No threat	52	12	43	9	83	17
Neutral	234	53	203	31	87	13

Conclusion

Modern biotechnology has been viewed as a frontier of the 21st century revolution and presents a range of potential environmental, social and economic benefits (Kamaldeen and Powell, 2000). On 11th July 2000, seven academies of science around the world issued a white paper spelling out the promise of agricultural biotechnology to alleviate hunger and poverty in the Third world. This report was part of an international move to persuade the public that biotechnological innovations in agriculture have a potential for good (Derbyshire, 2000).

Biotechnology has intensively developed its scope and breadth over the last ten years and has been the object of debate between supporters envisaging the potential benefits of technology, and opponents assuming the potential threats of biotechnology (Bloomfield, 2011). Public perceptions, level of understanding and acceptance of technology innovation will promote or hamper the commercial introduction and adaptation of new technologies (Kamaldeen and Powell, 2000). One of the research studies reveals that the level of public optimism on Biotechnology is very low when compared with other technologies like solar energy, computer, telecommunication and internet (Lulan, 2006). In this ambiguous situation about biotechnological innovations and their applications in various industries, we need to have an overview of factors which could determine Biotechnology Innovation for commercial application with a holistic approach apart from social, psychological, cultural and demographical issues.

There is a need to initiate public dialogue on pros and cons of biotechnological innovations to overcome the apprehensions of the society. The Government has to play a pivotal role in sustainable technology development to address the concerns of all the stake holders with systematically designed and evaluated mechanisms. The Government has to consider the views and concerns of the public along with scientific facts and the need to create technological awareness among the public for proper implementation of scientific innovations.

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