AGRICULTURAL BIOTECHNOLOGY AND INDIAN NEWSPAPERS

A Thesis

by

GAYATHRI SIVAKUMAR

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2004

Major Subject: Science and Technology Journalism

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Approved as to style and content by:

Susanna Priest (Chair of Committee)	Angela Bies (Member)
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ABSTRACT

Agricultural Biotechnology and Indian Newspapers. (August 2004)

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This study is designed to look into how agricultural biotechnology is covered by Indian newspapers. A through study of the literature showed that agricultural biotechnology is a much debated topic and there is a vast difference between the concerns expressed by its opponents in developed countries and those expressed by the opponents in developing countries. The research question was whether the sources used in an article determined the way in which this issue is framed. After conducting a content analysis of all articles written in *Times of India* between the time periods January 2001 – December 2003, it was found that the sources used did determine the way this issue was framed.

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INTRODUCTION

This study is designed to understand how agricultural biotechnology is represented in the Indian newspapers. Agricultural biotechnology is the subject of furious debate around the world and it will be interesting to see how this debate unfolds in the developing country. Differences in economic, social and cultural factors play into how this debate is shaped in the developing countries. Nearly 60% of India's population is employed in its agricultural sector. Agricultural biotechnology is perceived to have the power to change the very face of the agricultural sector. It would therefore affect the majority of the people in India. It will be especially interesting to see how the media in that country will portray this technology. This study is designed similar to the Eurobarometer studies of public perception of biotechnology conducted throughout Europe to study the media coverage and public opinion formation on agricultural biotechnology. However, this study deals with media coverage of agricultural biotechnology alone, not public opinion directly.

What Is Agricultural Biotechnology?

The simplest definition of biotechnology is "applied biology." It can also be described as application of biological knowledge and techniques to develop products. The techniques used for plant and animal breeding, fermentation and enzyme purification can also be considered as biotechnology as per this definition.

This thesis follows the style and format of *Journalism and Mass Communication Quarterly*.

Some people prefer to use the definition for the new tools of genetic science. In this context, biotechnology may be defined as the use of biotechnical methods to modify the genetic materials of living cells so they will produce new substances or perform new functions. Examples include recombinant DNA technology, in which a copy of a piece of DNA containing one or a few genes is transferred between organisms or "recombined" within an organism.[1]The term biotechnology "can be extended to any technological manipulation of a biological process, ranging from wine making to the construction of mechanical prostheses….".[2]As the definition suggest biotechnology applications are used both in agriculture and medicine. According to Gaskell, Bauer and Durant,

> Modern biotechnology is the third strategic technology of the post war period following nuclear power in the 1950's and 60's and information technology in the 1970's and 80's. These have all been identified as strategic technologies in their days, in the sense that they have been seen to carry the potential to transform our future life.[3]

Given the general perception of the power of biotechnology, it is understandable that there is a lot of interest in this technology around the world and especially in developing countries. Biotechnological applications have been changing the face of agriculture since its commercial introduction in 1996. According to one author," Modern biotechnology is a tool that allows scientist to select a single gene for a desired trait, incorporate it into plant cell and grow plants with the desired traits [4]. According to United States Department of Agriculture, Agricultural biotechnology is a collection of scientific techniques, including genetic engineering, that are used to create, improve, or modify plants, animals, and microorganisms. Using conventional techniques, such as selective breeding, scientists have

been working to improve plants and animals for human benefit for hundreds of years. Modern techniques now enable scientists to move genes (and therefore desirable traits) in ways they could not before - and with greater ease and precision.[5]

Debate on Agricultural Biotechnology

From the very onset, modern biotechnology was viewed as having extraordinary and potentially far-reaching implications.[6]To understand the impact of agricultural biotechnology on India, I shall first talk about why agricultural biotechnology is discussed and debated about so fiercely around the world.

As with the case with any new invention, biotechnology also has its own set of supporters and opponents. The debate about agricultural biotechnology as sound science and the benefits or risks associated with this technology has divided public opinion around the world. The most interesting part of this debate has been the totally opposite pictures painted by the proponents and opponents of this technology. The supporters of biotechnology see it as a tool to feed the world's ever growing population, increase the agricultural yield, create wealth for farmers, treat diseases and further a better understanding of the human body and help to manipulate it for greater good. In an article, J. B. Penn, says that use of agricultural biotechnology techniques help in enormous decreases in pesticide use, with corresponding environmental enhancement, along with equally dramatic increases in production and savings in production costs. While biotech results vary by farm, the economic benefits obviously have been significant. These benefits are realized not only by farmers, but also by the environment and to consumers in general. [7]

After a careful study of the literature, the arguments advanced in favor of agricultural biotechnology can be summarized under the following points.

- Increased food production at reduced cost, thereby ensuring cheaper food.
- Increased nutrition through varieties like ‘Golden Rice’.
- Decrease in water pollution due to decreased dependence on chemical pesticides and fertilizers.
- Helps environment by reducing pollution and helps to grow more food in less area and therefore save forest areas from being claimed as agricultural land.
- Can help biodiversity by creating more varieties of plants and by using cloning techniques to reproduce endangered species.
- Can help feed the world’s increasing population.
- Can help farmers become more prosperous by reducing farmers dependence on fertilizers and pesticides.
- Herbicide-resistant crops encourage the adoption of conservation tillage, especially no-till, which reduce erosion of topsoil.

Whereas the supporters of this technology talk about the benefits of this technology, its opponents see this technology as anti-poor and anti-environment. According to Miguel A. Altieri the various problems created by this technology are:[8]

- Biotechnology is a technology under corporate control, protected by patents and IPR, and thus contrary to farmers' millenary traditions of saving and exchanging seeds.
- Hunger is linked to poverty, lack of access to land, and misdistribution of food. Biotechnology exacerbates inequalities underlying the causes of hunger.
- Transgenic crops pose a range of potential environmental risks that threaten the sustainability of small farming systems. The ecological effects of engineered crops are not limited to pest resistance and creation of new weeds and pollution of

landraces. Transgenic crops can produce environmental toxins that move through the food chain, and also may end up in the soil and water affecting invertebrates, and probably ecological processes such as nutrient cycling. Moreover, large-scale landscape homogenization with transgenic crops will exacerbate the ecological vulnerability already associated with monoculture agriculture.

- There is widespread consensus that yields have not increased with transgenic crops. In the case of Bt corn the economic advantages are not clear, given that the occurrence of insect pests is unpredictable.
- Savings in insecticide use are minimal when examined on a per hectare basis, and insignificant when compared to savings derived from Integrated Pest Management strategies. Herbicide use is up, locking farmers to broad-spectrum herbicides that narrow weed management options and condemn farmers to monoculture.
- There are agro-ecological alternatives to biotechnology that result in technologies that are cheap, accessible, risk averting, productive in marginal environments, environment and health enhancing, and culturally and socially acceptable.
- Policies must be put in place to promote the up scaling of successful agro ecological interventions that are already reaching about 9,000,000 small farmers at one-tenth the cost incurred by official international agricultural subventions.

Impact of the Debate on Agricultural Biotechnology on Developing Countries

Countries like the US and Canada are promoting this technology, but many countries are not comfortable with it. They worry about environmental, social and economic consequences. Particularly in Europe, these consumer concerns have led to a resistance toward biotechnology-derived plants and food, though not medicine. Due to the public outcry

against this technology, European governments have been slow to permit the import of biotechnology-derived products. This decision has caused problems with countries like the U.S., which believe that agricultural biotechnology is based on “sound science” and therefore regulations against it will be in violation of the WTO (World Trade Organization) agreements.

The treatment of biotechnology-derived crops in the international trade market will have impact not just for biotechnology as a science but also to the future of agricultural produce trade. The World Trade Organization (WTO) Agreement on Sanitary and Phytosanitary Measures (SPS Agreement) requires that measures regulating imports be based on "sufficient scientific evidence" and that countries operate regulatory approval procedures "without delay."

So what does all this mean for developing countries? When the scientific community in the developed world is not able to present a unified stance on this technology and when they haven’t been able to convince their citizens about the benign nature of this technology, it is reasonable that developing countries, given their limited resources are wary about adopting this technology. With the U.S. and Europe engaged in a political and economical tussle with regards to this technology, developing countries are getting caught in between. Developing countries, depending on whether they import food or export food are forced to take a stance for trade reasons. Most developing countries import food from the U.S. and they have to accept GM food if they want to continue importing relatively cheaper food products from the U.S. These countries that import food must take a position on not only bio safety and food safety but also on whether they wish to insist on product differentiation and labeling in the case of imported food. It would be easier for these countries if such differentiation and

labeling demands were led by market forces or by its private sector. If the state tries to impose such constraints it might be found violating WTO regulations. Most developing countries export foods to the European market and they have to keep their agriculture GM free. According to Anderson,

> Since Argentina has introduced GM seed in a large share of its soybean production, it will be facing some of the same problems currently being faced by the United States. Brazil, on the other hand, has not yet officially introduced GM soybeans in its production system, and although allegedly GM seeds have found their way across the border from Argentina, Brazil is still in a position to claim that its soybean export is largely free of genetic modification. This would strengthen its position in the European market.[9]

According to Reuters, the EU has warned Thai rice exporters that the EU may reject Thai rice if any GM organisms are found in it.[10] Developing countries, which might want to embrace agricultural biotechnology, will not be able to export their food products to the EU under current circumstances. Of course, developing countries could choose to differentiate and label GM foods and non-GM foods and, if they can manage such a differentiated system, they would be able to use modern biotechnology and agriculture for domestic consumption while maintaining an export market for GM-free foods. Developing countries may also decide to label GM foods and GM-free foods in the domestic market to provide the choice to domestic consumers. However such a system might not be feasible. A developed country like the U.S. insist that it is very expensive to maintain such a system and the cost incurred by this differentiation would make its GM food more expensive. It is very unlikely that a developing country will have the resources or expertise to maintain such a differential system.

Because of its size and progress in the area of modern biotechnology for agriculture,

China will be an important player in the international trade negotiations related to GM foods.

Impact of Agricultural Biotechnology on India

India has the concerns of other developing countries but in its case the problem is even more complicated due to a variety of factors. According to CIA, Agriculture in India accounts for nearly 65% of the country's employment, 26% of the total GDP and nearly 20% of total export earning and supplier of raw material to major industries.[11] According to the Department of Biotechnology, India, Agriculture is not only the backbone of Indian economy and food security but also a way of life, a tradition and anchor of overall livelihood opportunity for about 700 million of our one billion populations. Agriculture, therefore, is and will continue to be central to all strategies for planned socio-economic development of the country.[12] India is a developing country and given its unique characteristics the effect of a powerful technology in this country will have economic, political and cultural implications. Let us take a look at the characteristics, which make this country different from the others.

1. Population

India's population is estimated around 1,049,700,118.[13] Nearly one third of the poor live in this country and an estimated 320 million people go to bed hungry in this country.[14]Proponents of Agricultural Biotechnology claim that by using the technology India can dramatically increase their food production and provide food for its ever-increasing population at a cheaper rate. The opponents of this technology argue that food shortage is not a problem. In fact, 60 million tones of food grains are stacked in the government granaries and allowed to rot. The problem is the lack of professional help to distribute this excess grain. They also argue that given the fact that Indian farms are small and labor intensive; the production cost will go up if they try and use the biotechnological applications which are

better suited for the capital intensive farming practiced in the developed countries. The government of India finds itself in a difficult position while taking a decision on agricultural biotechnology. Having missed the industrial revolution due to colonial rule, the Indian government does not want to be left behind in case agricultural biotechnology reaps humongous benefits for other countries. At the same time they are aware that they stand to loose the most if it fails. 60% of its population depends on agriculture for its livelihood and it cannot afford to endanger their income. It is feared that agricultural biotechnology developed to suit the capital intensive farming structure prevalent in a developed country might render the landless agricultural laborers in India unemployed. India's industrial sector is not developed enough to provide employment for these people. No political party will be able to bear the cost of alienating its rural vote bank.

2. Culture

Indian culture is very different from most of other cultures in the world. 81.3% of Indian population follows the Hindu religion.[15] The Hindu religion talks about 'vasudhaiva kutumbkam', which means the earth family. Indian cosmology has never separated the human from the non-human. The Hindus worship the plants, animals, rivers and the stones to show that they understand that every living and nonliving object in this world has as much right on this planet as the humans. When the issue of the patenting of life emerged, there was lots of resistance against it. People found it immoral. Life is not a monopoly and the concept of patenting a product of nature violates the basic principle for these people. Vandana Shiva in an interview with *Motion Magazine* said;

> When we plant a seed there's a very simple prayer that every peasant in India says:

> "Let the seed be exhaustless, let it never get exhausted, let it bring forth seed next year….

So far human beings have treated it as their duty to save seed and ensure its continuity. But that prayer to let the seed be exhaustless seems to be changing into the prayer "let this seed get terminated so that I can make profits every year" which is the prayer that Monsanto is speaking through the terminator technology -- a technology whose aim is merely to prevent seed from germinating so that they don't have to spend on policing.[16]

3. Colonial Past

Due to its colonial past, Indian government have till recently been vary of allowing foreign firms into India. The British East India Company first came to India for trade and so did companies from Portugal and France and all these countries colonized parts of the country for more than a century. People have survived in the third world because in spite of the wealth that has been taken from them but they fear that this technology will result in loss of control over the bio diversity and this is a loss they might not be able to withstand. People in rural India survive because they grow their own food, make their own medicine and grow their own fodder for the cattle. They do not have the money necessary to buy these basic requirements. According to the opponents of biotechnology in India like Vandana Shiva,

> Now this last resource of the poor, who had been left deprived by the last round of colonialization, is also being taken over through patenting. And seeds which peasants have freely saved, exchanged, used, are being treated as the property of corporations. New legal property formations are being shaped as intellectual property rights treaties, through the World Trade Organization, trying to prevent peasants of the third world from having free access to their own seed, to have free exchange of their own seed. So that all

peasants, all farmers around the world would be buying seed every year thus creating a new market for the global seed industry.[17]

The fears that the multinational corporations will try and take over has been strengthen by the moves made by the moves by various biotechnology firms to patent crops and plants like basmati rice, neem and turmeric. These plants and herbs have been used in India from very ancient times.

4. Credibility of the Government Agencies

The credibility of the Indian government and government agencies has been low in India. The results of past three general elections prove this point. For quite some time now, no political party has been able to secure a full majority in the Indian parliament. Indian political establishment does not have very high credibility with the Indian public. According to Rediff, In the Global Corruption Index, a survey of 133 nations conducted by Transparency International (an anti-graft watchdog), India stood 83rd in the world, alongside Malawi and Romania.[18] Indian politicians are often caught in corruption scandals; therefore there is a growing fear that MNC's could get away with causing environmental and economic damage with the help of these corrupt politicians. Past controversies like the Bhopal gas tragedy has decreased public trust in its government and increased fear about investing too much power in private sector in the absence of a credible political establishment to govern and regulate them.

Importance of This Study

This study is designed to understand how Indian media represents Agricultural Biotechnology. I have already talked about how important Agricultural Biotechnology is to India. The mass media acts like a major forum of the public sphere in modern societies. The

mass media may be viewed as "channels" of communication both from government to the public and from the public to government. We treat the media as a "cultural indicator" that documents the emerging social representation of genes and genetics in late 20th century Europe.[19] There is general agreement in the literature that the mass media are enormously influential, but less agreement about the exact nature of this influence. Studies have suggested that most consumers get their information about biotechnology from the media[20], while the level of trust in what they learn is very low. According to the National Academy of Science (NAS), it is imperative "to develop a genetically literate public that understands basic biological research, understands elements of the personal and health implications of genetics, and participates effectively in public policy issues involving genetic information".[21]According to Priest, public opinion reaction about agricultural biotechnology is primarily media driven as the "media set agendas for the rest of us and suggest certain interpretations over others".[22] In order to understand the public opinion formation regarding this technology, it will become important to understand how Indian media perceives agricultural biotechnology. A lot of studies have been done to understand how agricultural biotechnology issues have been represented in the media in US, Canada and Europe. Not much has been studied about the way agricultural biotechnology is perceived by the Indian media. As per the arguments so far, it is not possible to generalize the results and conclusion of any study based in any developed country to understand Indian reaction as there is a vast difference in the economic, political and cultural environment existing in a developing and developed country.

LITERATURE REVIEW

History of Agriculture in India

India's development path is powerfully influenced by its colonial past. For decades after independence, India's development strategy was framed by its struggle for, and acquisition of, independence from Great Britain in 1947. After a century of British rule, India was left impoverished. India, under British rule had changed from a food surplus state to a state unable to feed its citizens. One of the main reasons given by historians is that the British government succeeded in converting India's farmers from food producer to cash crop producer. Having missed the Industrial revolution, India at the time of Independence didn't have any major industry. It was just exporting raw materials to feed the British industries, therefore the thrust areas of development of Independent India was Industrialization. India's development path was defined by the project of nation building and inspired by the ideals of self- rule and self- sufficiency drawn from the independence movement.[23] In the emergent post- colonial context, these ideals were re interpreted in such a way that the achievement of national self – sufficiency was an important component of nation building. Jawaharlal Nehru, the first prime minister of free India observed:

> The objective for the country as a whole was the attainment as far as possible of national self-sufficiency. International trade was certainly not excluded, but we were anxious to avoid being drawn into a whirlpool of economic imperialism… [24]

In the years after attaining independence India pursued a policy of import substitution industrialization (ISI). Although agriculture was acknowledged as important for development, Indian planners prioritized industrialization.[25] There was a lot of protest to the

emphasis given to industrialization, especially since the Father of the Nation, Mahatma Gandhi always said that just as the whole universe is contained in the self, so is India contained in the villages. Nonetheless, achieving self-sufficiency in food production was an objective, if not a priority, at this time. Indeed, in 1947 the Foodgrains Policy Committee stipulated that dependence on food imports should be phased out and that India's food problem, consisting of the chronic shortfall of the actual from the required quantity of food produced domestically, should be solved by increasing domestic agricultural production. [26]

The increased tensions between Soviet Union and United states during 1950s and 1960s increased the strategic significance of South Asia and influenced India's agricultural policy and development in many ways. India, like many other newly independent developing countries, responded to the Cold War by adopting (at least in principle) the position of non-alignment as a key element of its foreign policy.[27] The philosophy of the non- aligned movement placed emphasis on self- sufficiency. This philosophy was in tune with India's goal of food self- sufficiency. Thus, the heightening of Cold War tensions imbued food self-sufficiency with renewed relevance, as did its 1965 war with Pakistan. Around the same time there was a series of natural disasters, notably an extended drought in southern India and severe earthquakes and floods in Assam. About 6 million tons of grain and other foodstuffs were lost, according to an official estimate made in November. During the resultant famine, large sections of the population were forced to subsist on a daily ration of 57 g (2 oz) of rice. India appealed to the United States in December 1950 for $200 million worth of food. In February 1951 U.S. President Harry S. Truman asked Congress to enact legislation providing 2 million tons of grain for Indian relief. Donor strategies and policy priorities, especially those of the US, add a further dimension to the global-national interplay around India's

agricultural development[2.8] In 1956 India (revealing one of many internal contradictions in its policy of nonalignment) signed a Public Law-480 agreement, under which it received US grain on concesional terms. Insofar as PL-480 played an important role in the US strategy of containing communism, US foreign policy and India's agricultural development policy became intertwined.[29] "It is in the context of this intertwining that neo-Malthusian discourses of a population 'explosion' acquired salience in donor policy during the Cold War".[30] Citing population growth in the developing world as an issue relevant to its perspective on national security, the US intellectual and policy elite posited a causal link between overpopulation', hunger, political instability, and communist insurrection.[31] Curbing population growth and hunger both became priorities in the American development agenda, and breaking this chain of causation involved the 'enlightened transfer of modern technology'.[32] In combating hunger, the efforts of agricultural science to increase yields figured prominently.

In India, the Green Revolution era was heralded by the introduction of dwarf wheat varieties imported from Mexico that showed the potential for massive yield increases, and the opportunity for a major technological boost to the agricultural sector. The term "Green Revolution" is applied to the period from 1967 to 1978. Between 1947 and 1967, efforts at achieving food self- sufficiency were not entirely successful. Efforts until 1967 largely concentrated on expanding the farming areas. But starvation deaths were still being reported in the newspapers. This called for drastic action to increase yield. The action came in form of the Green Revolution.

What Was the Green Revolution in India?

According to the Indian Council of Agricultural Research, there were three basic elements in the method of the green revolution (ICAR):[33]

1. Continued expansion of farming areas; the area of land under cultivation was being increased right from 1947. But this was not enough in meeting with rising demand. Other methods were required. Yet, the expansion of cultivable land also had to continue. So, the Green revolution continued this quantitative expansion of farmlands.
2. Double- cropping existing farmland; Double cropping was a primary feature of the Green Revolution. Instead of one crop season per years, the decision was made to have two crop seasons per year. The one season per year practice was based on the fact that there is only one natural monsoon per year. To enable double cropping, there had to be two "monsoons" per year. One would be natural monsoon and other an artificial monsoon. The artificial monsoon came in the form of huge irrigation facilities. Dams were built to arrest large volumes of natural monsoon water, which were earlier being wasted. Simple irrigation techniques were also adopted.
3. Using seeds with improved genetics: This was the scientific aspect of the Green Revolution. Indian Council for Agricultural Research (ICAR) was reorganized in 1965 and then again in 1973. It developed new strains of high yield value (HYV) seeds, mainly wheat and rice but also millet and corn.

Results of the Green Revolution [34]

1. The Green Revolution resulted in a record grain output of 131 million tons in 1978-79. This established India as one of the world's biggest agricultural producers. India also became an exporter of food grains around that time.
2. Yield per unit of farmland improved by more than 30 per cent between 1947 (when India gained political independence) and 1979 when the Green Revolution was

considered to have delivered its goods.

3. The crop area under HYV varieties grew from seven per cent to 22 per cent of the total cultivated area during the 10 years of the Green Revolution. More than 70 per cent of the wheat crop area, 35 per cent of the rice crop area and 20 per cent of the millet and corn crop area used the HYV seeds

History of Biotechnology in India

There was increased fear about India's ever increasing population. For the past four decades, India's agricultural policy making has focused almost exclusively on the issue of ensuring food security to the growing population of the country. This orientation in policy making resulted in the adoption of the strategy to realize the objective of self-sufficiency in food grains production in the country. Biotechnology has been seen as contributing to the development of Indian agriculture. In 1986 a separate Department of Biotechnology set up. The agricultural universities and research centers set up during green revolution era were already working on hybrid plants and GMO (genetically modified seeds) seeds. The Indian government promoted Biotechnology in a big way. "Attaining new heights in biotechnology research, shaping biotechnology into a premier precision tool of the future for creation of wealth and ensuring social justice - especially for the welfare of the poor".[35]This is the vision statement of the Department of Biotechnology, Government of India. The mission of this department as per its website is

- Realizing biotechnology as one of the greatest intellectual enterprises of human kind, to provide the impetus that fulfills this potential of understanding life processes and utilizing them to the advantage of humanity.
- To launch a major well directed effort with significant investment, for

harnessing biotechnological tools for generation of products, processes and technologies to enhance the efficiency and productivity and cost effectiveness of agriculture, nutritional security, molecular medicine, and environmentally safe technologies for pollution abatement, biodiversity conservation and bio industrial development.

- Scientific and technological empowerment of India's incomparable human resource.
- Creation of a strong infrastructure both for research and commercialization, ensuring a steady flow of bio products, bioprocesses and new biotechnologies.[36]

One of the most significant statements about the role of biotechnology in furthering the fortunes of Indian agriculture was made in the National Agriculture Policy presented in the year 2000. The National Agricultural policy, which presented the blueprint for the agricultural sector for the next two decades, explored the options to ensure that growth of the sector is sustainable technologically, environmentally and economically. Biotechnology was seen as one of the alternatives for achieving this objective. The policy stated that the use of biotechnologies would be promoted for evolving plants that are drought resistant, pest resistant, consume less water, contain more nutrition, give higher yields and are environmentally safe. The department of biotechnology has complemented this initiative by policy makers in the agricultural sector by advancing their justification for the use of biotechnology for agricultural growth. According to DBT, the post green revolution era has almost merged with the gene revolution for improving the productivity and quality of crops. The exploitation of heterosis vigor and the development of new hybrids including apomixes, genes for a biotic and biotic resistance, and development of planting material with desirable

traits and genetic enhancement of all important crops will be the focus of the agricultural research agenda in the future. In addition to providing improved quality of plant material; biotechnology has been seen as contributing to integrated nutrient management and development of new bio fertilizer and bio pesticides, inputs that would be crucial from the point of view of realizing the objectives of sustainable agriculture, soil fertility and clean environment. Biotechnology has thus been seen as a key input towards bringing a radical transformation of agricultural practices in India, one that involves a greater use of biological software on a large scale.

The above-mentioned objectives that the policy makers have set for biotechnology in the context of transforming Indian agriculture have been reflected in the research priorities set by the DBT in recent years. The Department has been promoting research to enhance food and agricultural production, quality and nutritional improvement and prevention of pre and post harvest losses. These research efforts have, according to the DBT, provided significant leads in the areas of basic plant biotechnology and plant genome research, development of makers of high quality protein content and development of molecular methods for hybrid mustard and production of transgenic plants of tobacco with viral resistance.

In 1991, India accepted a six billion dollar loan from International Monetary Fund (IMF), which, among other things, obliged it to liberalize its industrial licensing policy and relax the terms on which multinationals could enter the Indian economy. The new Industrial policy was implemented in response to these conditions and gave automatic approval to foreign technology agreements and to Indian subsidiaries with up to 51 percent foreign equity. The completion of the Uruguay Round of the General Agreement on Tariffs and trade

(GATT) and the subsequent creation of the World Trade Organization (WTO) in 1994, of which India is a member, were watersheds for contemporary forms of globalization and hold many implications for the biotechnology industry in India.

As a result of these economic changes nationally and globally, private sector involvement in India's agricultural sector has increased. Indeed, in the contemporary period it is private companies (Indian and multinational) that are the key players in the development of new seeds and biotechnology, rather than public research institutes and private philanthropic organizations and donors, as in the green Revolution era. While the rate of annual growth of investment in public research fell between the period 1971- 80 and 1981-93[36], private sector investment in R&D has increased significantly since the reforms.[37] Thus, for example, the number of private seed companies engaged in research and development (R&D) rose from 9 in 1985 to 40 in 1995.[38] Correspondingly, R&D expenditures between 1987 and 1995 also grew in real terms (1981/2) from 13.1 million rupees to 46.5 million rupees.[39]Agricultural and food sectors that were under state patronage are now exposed to MNC's like Dupont, Monsanto and Syngenta.

Media and Agricultural Biotechnology

Studies have suggested that most consumers get their information about biotechnology from the media,[40]while the level of trust in what they learn is very low. The media everyone agrees influences public opinion and policy making but there is no clear set way in which this operates. Media does help to the extent that it brings an issue into focus. If the media do not cover a particular story, the public tends to ignore that issue. The tone of information in the media has an important impact on consumer perceptions. Consumer perceptions and understanding of agricultural biotechnology have been strongly influenced by the type of

information provided by the media, confidence in governmental safeguards, and cultural preferences, says Thomas J. Hoban, Professor, Department of Sociology and Anthropology, North Carolina State University.[41]In case of Agriculture biotechnology, much of the debate around it has been centered on whether it is sound science or not. Not many common people have the knowledge to decide on this controversy on their own. They depend on the media to explain it to them in simpler terms and also depend on it to hear opinions from different groups. The science of biotechnology is sophisticated, rapidly changing, and hard to understand and communicate to lay audiences. While studies of public attitudes and awareness of biotechnology have reported that many Americans are positive about plant biotechnology,[42]consumers have also cited a number of concerns regarding plant biotechnology. Studies have shown [43]that consumers perceive risks of plant biotechnology to include food and worker safety, increased resistance to pests creating "super weeds," potential decline in genetic and phenotypic variability and biodiversity, fears about expression of genetic material from pathogens causing disease harmful to other plants, animals and humans; and uncontrolled (and perhaps unintended) gene transfer "upsetting nature's balance".[44]

Research indicates that consumers from different parts of the world have very different perceptions and understanding of agricultural biotechnology .Researchers have attempted to explain the disparity in public opinion regarding biotechnology in the United States and Great Britain. One study,[45] consisting of surveys of attitudes in Europe and the United States, found that knowledge and understanding of biology and science did not explain the greater acceptance among U.S. consumers; Europeans scored significantly higher than Americans on knowledge. However, the same study[46] found that Americans rated their trust

in national government agencies considerably higher than did Europeans. Ninety percent of Americans demonstrated trust in the USDA (United States Department of Agriculture) regarding the safety of biotechnology and 84% displayed trust in the FDA (Food and Drug Administration). In contrast, only 4% of European respondents demonstrated trust in their national public bodies regarding the safety of biotechnology. Gaskell, studying differences between European and U.S. acceptance of biotech foods, argued that the influence of three factors—difference in press coverage, trust in regulatory procedures and level of knowledge—might account for the relatively greater European resistance to agricultural and food biotechnology.[47]According to Priest, public opinion reaction about agricultural biotechnology is primarily media driven as the "media set agendas for the rest of us and suggest certain interpretations over others".[48]This implies that the media is framing the information about biotechnology.

A frame can be defined as " a central organizing idea for news content that supplies a context and suggests what issues is through the use of selection, emphasis, exclusion and elaboration".[49] Journalists can be seen as brokers, "framing social reality and shaping the public consciousness".[50] Often media go beyond setting an agenda for the public to suggesting validity for certain opinions, interpretations, and definitions of a controversial issue.[51]Studies conducted on how individuals without special technical training in a field come to a conclusion about the level of risk involved,[52]the knowledge individuals have is often influenced by mass media content.[53]Many studies of framing involve controversial scientific or medical topics, which are inherently complex.[54]In communicating risk, what the media states or omits can define issues for the general public. [55]

Indian newspapers are designed much like the British newspapers. There is no

emphasis on ‘unbiased’ news in the Indian media like in the United States. The result of such policy is that different newspapers cover the same issue in a variety of ways depending on their affiliation or philosophy. Indians newspapers tend to frame an issue from the point of view of the sources interviewed. It has to be noted that these sources also use the media to frame the issue in their own way.

Recent studies on agricultural biotechnology show that generally across the world, the political establishment, Biotech companies and industrial establishments support this technology. Advocacy organizations and public interest groups generate opposition to this technology. It is logical to assume that this division in opinion will be prevalent in India also. The Indian newspaper would give coverage to different interest group to help inform the readers about various opinions centered on this controversy. My research question would be

RQ: Will the source used determine the way this issue is framed?

METHODOLOGY

For this study, I conducted a content analysis of Indian newspaper coverage of Agricultural Biotechnology. Content analysis according to Kerlinger is a method of studying and analyzing communication in a systematic, objective and quantitative manner for the purpose of measuring variables.[56] Walizer and Wienir define it as any systematic procedure devised to examine the content of recorded information.[57]According to Wimmer and Dominick there are roughly ten steps in content analysis.[58]

1. Formulate the research question or hypothesis
2. Define the population in question.
3. Select and appropriate sample from the population.
4. Select and define a unit of analysis.
5. Construct the categories of content to be analyzed.
6. Establish a quantification system.
7. Train coders and conduct a pilot study.
8. Code the content according to the established definitions.
9. Analyze the collected data.
10. Draw conclusions and search for indications.

The research question for this study was given in the previous chapter, in this chapter I will deal with the methods used in this study. India has the largest number of daily newspapers in the world with over 4,453 publications.[59] For this study; I choose to study only English language newspapers published in India for the following reasons.

1. Language barrier- In India, fifteen national languages is recognized by the Indian constitution and these are spoken in over 1600 dialects. English is considered to be a neutral language. English along with Hindi are the official language used by the union government. The most popular press in India is the vernacular press.
2. Accessibility – The English language newspapers are the only once that can be accessed from the US, as they are available on the Internet. The top three selling newspapers are vernacular newspapers and are not available on the web. The only way to get access to the archives of these newspapers is to go to their corporate office personally and get access to their archives or to visit any public library in India.
3. Limited resources- I do not have enough economic resources to employs translators to read and translate various articles printed in the vernacular press. So I have to limit my sample to English newspapers.

In the next stage, I chose to study Times of India (TOI) from all the English language newspapers published in India. I choose to study TOI for a various reasons.

1. According to the National Readership Survey (NRS) 2003, TOI is the only English language newspaper to figure in the top ten selling newspaper in India.[60]
2. TOI is one of the few national newspapers in India. It has a presence in almost all major cities and towns in India and is not limited to a region like The Hindu or The Telegraph.
3. According to NRS 2003, TOI has the highest circulation figures in New Delhi, the capital of India. Most of the policy decisions are made by the Indian parliament, which is based in New Delhi, and the newspaper, which is widely read, in that city

becomes an "opinion leader". "By 'opinion leading', we refer to outlets that are read by decision makers for information and by other journalist for inspiration". [61]

In the third and final stage of multistage sampling I choose to analyze only those articles that were published in The Times of India between Jan 2001 to Dec 2003. I choose to analyze articles over a three years period because

1. By choosing three years, I will be able to study the difference in coverage over two-year period. In case there was increase in coverage in a particular span of time due to some incidents like BT Cotton failure, it will be noticeable.
2. The time period selected Jan 2001 – Dec 2003 makes the articles studied current and relevant to the time of study.
3. I also had only sufficient time and resources to conduct a three-year study.

The next stage in content analysis is to select and define a unit of analysis. The unit of analysis for this study would be every single article published during Jan 2002 – Dec 2003 period in the TOI with regards to Agricultural Biotechnology. A few keywords were used in the search of relevant material from the online archives of TOI. The keywords or the search words include " Agricultural Biotechnology", " Ag Biotech", "Ag Biotechnology" and 'GMO'.[62]

TOI website offers a historical index of articles. All the articles found through the various keyword searches were printed out and coded. The content was coded on the basis of four categories.

1. Rating and judgment- According to this category, the articles are coded on whether the tone of the article was a) Positive towards agricultural biotechnology as a science, application or as an institution. b) Negative towards agricultural biotechnology as a

science, application or as an institution. c) Neutral towards agricultural biotechnology as a science, application or as an institution. d) Represents both positive and negative viewpoints in the same article. e) Neutral tone or evaluvatory tone towards agricultural biotechnology as a science, application or as an institution. f) Not applicable.

2. Main issue or theme for the article- the issue ('s) or theme ('s) behind the article is noted. In some cases, there will more than one theme in the same article. The themes of the articles will then be then divided into five main categories. These themes will be based on the findings of the content analysis.
3. Sources- the main sources of each article will be identified. Sources include a) main player interviewed or referred to in the article b) In case of the article is written by a guest columnist, the allegiance of the columnist, if easily identifiable.
4. Frames- another category of coding would be the frames used by the various source groups to describe agricultural biotechnology as a science, application or as an institution. For the purpose of this study I have used the same frames used in the Eurobarometer survey.

According to the Eurobarometer[63] study, the term 'frame' is used with the following preliminary definition: a frame is a structure that:

1. organizes central ideas on an issue
2. deploys particular symbolic devices and metaphors
3. defines a particular controversy within the frame (i.e. an agreement about how to disagree). A frame's function is to construct meaning, incorporating new events into its interpretative envelope.

Frames used in this study: [64].

1. ‘Progress’: celebration of new development, breakthrough; direction of history; conflict between progressive/conservative – reactionary.
2. ‘Economic prospect’: economic potential; prospects for investment and profits; R&D arguments.
3. ‘Ethical’: call for ethical principles; thresholds; boundaries; distinctions between acceptable/unacceptable risks in discussion on known risks; dilemmas. Professional ethics.
4. ‘Pandora’s box’: call for restrain in the face of the unknown risk; the ‘opening of flood gates’ warning; unknown risks as anticipated threats; catastrophe warning.
5. ‘Runaway’: Fatalism after the innovation; having adopted the new technology/products a price may well have to be paid in the future; no control anymore after the event.
6. ‘Nature/nurture’: environmental Vs genetic determination; inheritance issues.
7. ‘Public accountability’: call for public control, participation, public involvement; regulatory mechanisms; private versus public interests.
8. ‘Globalizations’: call for global perspective; national competitiveness within a global economy; opposite: splendid isolation.

The quantification system used in this study is nominal. According to nominal level, the researcher simply counts the frequency of occurrence of the units in each category .[65]

Due to time and economic constraints, I have had to code all the data myself. So there was no need for training coders or conducting inter-coder reliability test. The articles that were selected were coded on the basis of the above-mentioned categories in an excel worksheet and the frequency of occurrence were calculated.I conducted Chi – square analysis between sources used and frames employed to check whether the sample size was big enough and whether the result obtained were significant. The test showed that the result were significant at .05 level.

RESULTS

The results of the analysis can be summarizes as follows. A total of 45 articles were identified as meeting the selection criteria used in the analysis. Out of these 45 articles, 30 articles were published in the year 2002(66.7%). 12 articles were covered in the November – December period. 8 articles were published in 2001 and 7 articles were published in 2003. Of the 45 articles, 21 articles were positive about Agricultural Biotechnology as a science or applications. 6 articles were negative, 8 neutral and 6 articles contained both positive and negative viewpoints.

The main issues covered in these articles are Business (17 articles), Science and Technology (6 articles), Risk associated with this technology (12 articles), Policy aspect (2 articles) and biotechnology as aid for social development and environment protection (12 articles). Of the 45 articles, 27 were published in the national news section, 6 in the business section, 6-opinion section, 4 in the science and technology section and 2 editorials.

The sources used can be broadly classified as a) Cabinet ministers, Chief ministers, Government officials in various ministries, scientist working in Government research institutes B) Business representatives, both domestic and multinationals C) Advocacy groups, activists (domestic only) D) Scientist associated with various non government research institutes and companies E) Trade or professional groups F) International scientist and researchers G) International environmental activist.

Members belonging to group A were used as source 21 times, Group B was used 15 times, Group C were used 5 times, group D was used 11 times, group E was used 2 times, group F was used 8 times and group G was used 3 times.

The frames used maximum times were that of economic prospect and progress (12 times each) followed by Nature/Nurture (8 times), Public accountability (6 times), Pandora's Box and Ethical came next with (3 instances each) and Globalization came in last with just 2 instances.

When all the sources, for positive information, negative information and neutral information were listed out. MNC's, Government officials and scientist, Industry personnel and International scientist were among the sources for positive information. For negative information, the newspaper listed NGO's, Indian Seed Association, Scientist and International Activist as sources. For neutral information International scientist, scientist and newspaper correspondents were listed as sources.

On basis of this result Government officials, MNC's, Indian corporations can be clubbed together as the pro biotech group and the NGO's, Associations and International NGO's can be clubbed as anti biotech group.

There seems to be a divide among the scientific community on this issue as scientist who are associated with biotech companies speak for the technology and independent scientist are either neutral or against it.

When the frames of reference used by the pro, anti and neutral groups were listed, it was found that a) Pro biotech proponents used frames such as economic prospect, progress, and globalization. B) Anti biotech proponents were using ethical, Pandora's box and public accountability as the frames. C) The neutral group was solely concerned with nature/nurture framework.

DISCUSSION

The results show that sources used determine the frame used. It is possible to determine how the issue is going to be framed by finding out if the source belongs to the Pro Biotech or Anti Biotech group. Whenever the Government officials or scientist have been used as the source, they talk mostly about economic prospect or about progress. This could be because of many factors. In a developing country like India there are many proponents of the theory that economic progress comes first, environment or other factors later. The arguments being made are that a developing country like India cannot afford to sacrifice economic progress, which will benefit its huge population for environment, ecology and morality. This was best highlighted when for instance when there was an international convention about banning CFCs in fridges, or requiring reduced factory emissions, Former Indian Prime Minister, Indira Gandhi observed "poverty is the greatest polluter. Let's hope our good intentions don't end up prolonging poverty's grip on our fellow humans".[66] Bharathiya Janata Party or the BJP was in power during the years 1999-2004. BJP is very well known for its pro liberalization, pro middle class and pro industrialization policy. The National Agenda for Governance adopted by the BJP and its allies mentions the subject (Science and technology) briefly in its election manifesto. It promises the "integration of efforts in the field of science and technology with development efforts in various socio-economic sectors." It also promises greater support to national laboratories, the strengthening of research and development and the setting up of centers of excellence.[67] After BJP won the elections it went ahead and gave permission to open Biotechnology parks in various parts of the country to promote national growth and improve economy. BJP's policies of globalization and opening domestic market to international corporations have increased the prosperity of its

traditional vote bank, the urban middle class." Global corporations have set up a wide range of operations—from customized call-centers to research labs—producing a new layer of the middle class that leads a comparatively affluent lifestyle".[68] India's economy could grow 10 percent this year, figures Nariman Behravesh, chief economist for Global Insights in Waltham, Mass. "India could be on the verge of something of a takeoff."[69] This takeoff is what the BJP government wanted to highlight. Therefore its obsession with showcasing Biotechnology as means for increasing economic prosperity and as an aid for social development. Even though BJP have lost the elections in India, the government support for biotechnology seems to remain intact. "Asserting that the common man will not be ignored under his leadership, new Science & Technology Minister Kapil Sibal on Monday said the government would work towards simplification of regulatory procedures, especially with respect to biotechnology and retaining scientific manpower.[70]

MNC's and Indian corporation associate biotechnology with Progress or Science and Technology. The arguments they state are that progress is not possible without Science and Technology. They argue that knowledge economy of the 21st century has catapulted biotechnology into prominence. The race is to see which nations will emerge as global "bio-powers" in the coming decade. India has found itself a niche in IT. The question being posed is whether it can do the same in biotechnology. If intellectual capital is the prime driver, India has the natural advantage but there are other drivers that India needs to address in this pursuit for global excellence in biotechnology. According to an article written by Ranjan Narula in frontline, there are various reasons why India should adopt Biotechnology:[71]

Biotechnology is a knowledge-intensive industry and research is where huge opportunities lie for India. It has a good pool of scientific talent available at a very low cost. An English speaking population is another advantage, which India has over other developing countries. Biotechnology requires good IT infrastructure and knowledge, which is available in abundance in India. Basic research is essential in all aspects of modern biology. India boasts of a network of research institutes spread around the country established both by government and private sector. The Council for Scientific and Industrial Research (CSIR), the government body to promote scientific research, has a network of 40 laboratories, 80 field stations and 22,000 trained personnel. Also India has 29 agriculture universities and 204 central and state universities. The institutes are now entering into "knowledge alliance" with pharmaceutical units to develop genomic medicine. In these cases, the institute conducts research and development and the private firms handle the commercialization process. India has a rich and varied heritage of biodiversity, encompassing a wide spectrum of habitats from tropical rainforests to alpine vegetation and from temperate forests to coastal wetlands. These are obviously attractive for companies doing agriculture research, plant breeders and others. The Indian government has set up a separate Department of Biotechnology under the Ministry of Science & Technology. The department's objective is to involve the scientific community in promoting India as a biotechnology destination. Furthermore, the government in order to attract foreign investment in the biotechnology sector has established 'single window clearance system' for quick approval. It allows establishment of 100% foreign owned company where the proposal is to establish a Research & Development laboratory with the production facilities. Also a number of states in India, in particular, Maharashtra, Tamil Nadu, Karnataka and Bangalore have set up special zones and

biotechnology parks to encourage investment. The respective state government has formulated its own biotechnology policies and is offering tax incentives to companies setting up research and manufacturing facilities.

Given India's success in the IT sector and the rich dividends it paid for the middle class, it makes sense for the MNC's to connect IT and Biotechnology, The Indian media is dominated by people who belong to the Indian middle class and if the MNC's succeed in projecting biotechnology as technology which will increase the economic power for this section, it is very likely that it will get the attention and approval of the Indian media.

Among the opponents of this technology, the NGO's and NGO activist are those who are in the forefront. Among the broad classification of NGO's, the most active NGO's are the environmental advocacy groups. Environment advocacy groups are part of public interest groups and they are groups that work on environmental issues. These environment advocacy groups argue that biotechnology firms can do a lot of harm to this country. They claim that biotechnology firms are doing no favors to this country. There are here because of several factors :

- Low cost of R&D - It is believed that in India, the operational cost of R&D is one tenth of that of more developed countries. Also the trend to outsource R&D in biotechnology is increasing. These companies want to increase their profits by sending jobs to India and paying less for it.
- Marine - India has a coastline of 8,000 kilometers and has 2 island territories of Andaman and Nicobar and Lakswadweep. Thus there is a great potential for these companies to exploit marine resource development and aquaculture here, where there are less stringent rules to check the impact.

- Agriculture - More than half country's population depends on agriculture for its livelihood. Fertilizers and herbicides have a huge market and the MNC's want to capture the market.
- Human Biodiversity - India has wide human biodiversity. Large joint families and hospital blood banks are some of the unlikely genetic treasure trove for these companies. NGO's caution that in the past western corporation have used Indian people as guinea pigs for many of their drug trials and this is just another instance where the poor and ill informed are being exploited

International environment advocacy groups have also joined the hands of the advocacy groups in India to provide the Indian media data on how agricultural biotechnology ' has gone wrong' in other countries.

International and national scientists seem to be the most divided group. Many scientists support the technology but there are a few opponents to this technology in this group. This could represent the divide in the way Scientist community view this technology and evaluate the risks presented by it. Many people have voiced concern about biotechnology and genetic engineering. Scientists have considered the issue of safety over recent years. A special committee of the National Academy of Sciences specifically reviewed the issues on the introduction into the environment of organisms genetically engineered using recombinant DNA technology. They concluded that "there is no evidence that unique hazards exist either in the use of R-DNA technique or in the transfer of genes between unrelated organisms," and that "the risks associated with the introduction of R-DNA engineered organisms are the same kind as those associated with the introduction of unmodified organisms." [72] In direct opposite claim, in a new review of scientific literature reported in the February issue of Harper's

magazine, Barry Commoner, a prominent biologist demonstrates that the bioengineering industry, which now accounts for 25-50 per cent of the US, corn and soybean crop, relies on a 40-year-old theory that DNA genes are in total control of inheritance in all forms of life. According to this theory - the central dogma - the outcome of transferring a gene from one organism to another is always "specific, precise and predictable," and therefore safe. Taking issue with this view, Commoner summarizes a series of scientific reports that directly contradict the established theory. In his article he says,

> Our leading scientists and scientific entrepreneurs (two labels that are increasingly interchangeable) assure us that these feats of technological prowess, though marvelous and complex, are nonetheless safe and reliable. We are told that everything is under control. Conveniently ignored, forgotten, or in some instances simply suppressed, are the caveats, the fine print, the flaws and spontaneous abortions. Most clones exhibit developmental failure before or soon after birth, and even apparently normal clones often suffer from kidney or brain malformations. ANDi, perversely, has failed to glow like a jellyfish. Genetically modified pigs have a high incidence of gastric ulcers, arthritis, cardiomegaly (enlarged heart), dermatitis, and renal disease. Despite the biotechnology industry's assurances that genetically engineered soybeans have been altered only by the presence of the alien gene, as a matter of fact the plants own genetic system has been unwittingly altered as well, with potentially dangerous consequences. The list of malfunctions gets little notice; biotechnology companies are not in the habit of publicizing studies that question the efficacy of their miraculous products or suggest the presence of a serpent in the biotech garden.[73]

With the scientific community to resolve the debate on whether Agricultural Biotechnology

is based on sound science, it looks like the society has to decide on whether this risk is worth taking.

Government sources and MNC's are being given maximum coverage. This could be due to various reasons. A) Government officials, elected representatives in the government are public personalities. Their opinions matter, as they are the policy makers. It is therefore not surprising that they get a lot of coverage.

B) Indian government has the largest budget for advertising. A number of newspapers depend on the government to earn their advertising revenue; it is therefore possible that newspapers tend to give a lot more coverage to government officials and institutions. The same is the case with Corporations. "It is the advertising revenue that keeps both the news and entertainment media in business".[74]C) Government institutions and the corporations have enough resources to organize press conference and distribute press releases. Therefore they might get more coverage that a NGO rally organized in a small village in India.

The spurt in coverage in 2002 can be associated with the chronology of Bt cotton in India. In 2001, there were only 8 articles were published on this issue and all but one had to do either with business issues or Science and technology issue. Only one article talked about the risk element involved in adopting this technology in a developing country. This was the time when India was first debating on whether to approve BT cotton for plantation. In 2001, there was a public interest case filed questioning the legality of allowing field trails in India. A few months before the court ruling, a ten-member delegation of US judges and scientist arrived in India to educate Indian Supreme court chief justice about Biotechnology. BT cotton field trials were allowed as to give technology a fair chance.

In 2002, 40 farmers in the state of Andhra Pradesh commit suicide as BT cotton fails.

The Department of biotechnology however declares it a success and the ICAR sends a report suggesting that BT cotton be allowed in the country. This was the time period when most of the articles related to biotechnology were published. At the time around Bt cotton failure a number of articles, which talked about public accountability and ethics, were published along with article, which talks about how biotechnology if properly used can be used to aid development. As the government delayed making its decision in 2003, the issue died down. It will be interesting to see how the new government will respond to the report sent by ICAR.

CONCLUSION

It can be concluded that this study has proved that it is possible to determine the way this issue is going to be framed if sources used can be identified as belonging to the Pro Biotech or Anti Biotech group. The study has helped in understanding that the concerns of the people in the developing countries are quite different from the concerns of the people in the developed countries as the political, social, cultural and economic factors are very different. It has to be noted that while sources used determine the way issue is framed, often it is in the hands of the journalist to choose the sources. It is disheartening to find out that not much coverage has been given to this controversy. An issue of this magnitude should be given more coverage to ensure that this issue is brought to the notice of the society. When a decision needs to be taken about adopting a technology, it is the responsibility of a democratic government to engage its citizens in the process of weighing the risks and benefits associated with it before taking a decision. It is the duty of mass media to ensure that debates regarding such decisions are brought to public notice.

Limitations

The limitations to this study are:

- Sample size is small.
- Study of vernacular newspapers would help understand Indian newspaper coverage better. Vernacular papers are read by most rural people and understanding how agricultural biotechnology is portrayed in those papers will help us in understanding the public opinion formation about this technology among people employed in agricultural sector.

- This study considered only one newspaper.
- This study did not take into account the prominence given to any article with regards to placement or article size.
- Did not compare results with results from studies conducted elsewhere.
- Did not consider the fact that journalist and the editors will have a say in the sources used and what part of the information given by the source is used.

Implications

The literature review proves that it is not possible to use the studies done in developed countries to understand how the controversy is being played out in developing countries, as the concerns are quite different. It is therefore necessary to conduct research based on developing countries to understand their position on any science controversy.

A study that will help measure public opinion on the issue of agricultural biotechnology will help in increasing the understanding of the entire issue.

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