CHAPTER ONE

1.0 INTRODUCTION

1.1 BIOTECHNOLOGY: ITS IMPACT AND CONTROVERSIES

Science and technology is continually revolutionising the world with increasingly rapid advancements that have widespread social and economic implications. The twentieth century was hailed as the century for physics, seeing the transformation of various fields such as transportation, telecommunications, information technology, space revolution, astronomy, nuclear physics and robotics. This century is shaping up as the century for biology (National Research Council, 2009), with biotechnology commanding recognition in the fields of agriculture, medical, environment, and industrial development. Specific to the health sciences, examples of these applications include research involving human embryos and stem cells, new and more potent biological weapons, research involving gene therapy and predictive medicine, genetically engineered vaccines and pharmaceuticals (Nisbet and Lewenstein, 2002) and reproductive techniques such as *in vitro* fertilisation (Altimore, 1982). Applications specific to agriculture involve novel or more resistant genetically modified plants and bacteria that overexpress or underexpress a gene or include new genes, as well as genetically modified or cloned animals that are designed to increase food production, manifest desired traits, or serve as biofactories to produce pharmaceuticals and organ transplants (Nisbet and Lewenstein, 2002). The global value of biobusiness is estimated to be US$9,776.3 billion in 2001 **(**Teng, 2008**).** With such promise, many countries are racing to be on the global biotechnology map.

In spite of the recognition earned by this sector, biotechnology has sparked debates. Growing recognition of the potential of biological technologies to increase agricultural productivity, with accompanying economic, public health, and other social implications, has fuelled an increasingly vociferous debate about the relative risks and benefits associated with applications of such scientific processes (Gunter, et. al., 1999). Given the magnitude of debate and interest caused by biotechnology around the globe, engaging the public on issues related to biotechnology is of paramount importance for scientists to understand public concerns, and also for the public to appreciate research and its needs. Controversies such as mad cow disease, climate change, genetically modified food, and cloning are all vivid examples of failure of effective communication between science and politics, as well as between science and society (Parsons, 2001), demonstrating how a lack of public-scientists communication can yield undesirable effects for both public/s and scientists.

1.2 BIOTECHNOLOGY COMMUNICATION BETWEEN THE SCIENTISTS AND THE PUBLIC

The importance of communicating science and technology to the public in an engaging and relevant way is generally acknowledged (Joubert, 2001; Triese and Weigold, 2002). Bensaude-Vincent (2001) cites the following as reasons for reaching out to the public on science and technology: combating obscurantism; satisfying the public's curiosity and appetite for knowledge; fulfilling a universal need; keeping the public up-to-date with respect to constant scientific progress; or informing citizens in order to enable them to exercise their rights.

However, a number of surveys suggest that public does not know much about science, and that scientists don't know much about the public (Miller, 1998; and Levy-Leblond, 1992). According to Kim et. al. (1996), the dominant concept of Public Understanding of Science takes basically the information provider's point of view. It concerns the scientist's sufficiency of scientific knowledge relative to the public's deficiency of it (Kim, 2007). This model, termed as "deficit model", characterised the public as having inadequate knowledge, and science as having all the required knowledge (Durant, et. al., 1989; Ziman, 1991). In spite of many efforts to bring scientists and the public closer through this method, the effect seems to be inadequate (Miller, 2001). This was also indicated in the UK survey in 1988 (Durant et.al., 1989). This gave rise to another approach, called the "contextual approach" where public knowledge of science is seen much more as a dialogue in which, while scientists may have the scientific knowledge and facts at their disposal, the members of the public have local knowledge and an understanding of, and personal interest in the problems to be solved (Miller, 2001). The importance of recognising local knowledge gave rise to two new models: lay expertise (Wynne, 1989) and public participation (Hamlet, 2002; Joss, 1999; Wachelder, 2003). These models are discussed under Literature Review in the next Chapter.

A good mix of the above models and appropriate use of them will provide an effective tool for public understanding of biotechnology. For society to develop economically, technologically, socially, and culturally, there is a need to educate the population at large, not only through the development of a school system but also through communicating scientific results to lay people (Kyvik, 2005). Besides the need to educate the public on scientific issues, there is also the need to engage the public on policy and decision-making. Libutti and Valente (2006) noted that a citizen who participates in the major scientific issues of the day, engages in discourse and helps determine good practice and codes of conduct will develop a critical faculty that will enable him or her to form an opinion on important political and social themes such as environmental protection, human rights, peace and so forth.

The need for a strong public understanding of biotechnology that is based on improved science literacy as opposed to a deficit-model based approach is outlined below:

1. **Enable public to make informed decision.** This is pertinent in order to form opinions and decisions on biotechnology-based issues and be able to participate fully in modern society, and to ensure the potential of biotechnology is harnessed while addressing valid concerns. Without scientific and technological information, it can be difficult to make even comparatively simple decisions (Nelkin, 1995; Wilson, 1998). Such matters as choosing a pet food, vitamins and health supplements, diets, and a constructive discussion with our doctors require a basic understanding of science. Hartz and Chappell (1997) suggest that the populous needs as much scientific information as possible to act wisely and intelligently in modern society.

2. **Enable public and scientists to harness the benefits of biotechnology and minimise abuse of it.** The benefits of the advancements of biotechnology can only be harnessed if society has good understanding of the technology, and the scientists on the social impact of it. The classical humanistic vision that science will naturally lead to social progress has been severely eroded, and scientists bear much of the responsibility (Fresco, 2003). Fresco suggests that scientists need to discuss more, and more concretely, "where we want to go" and what roads we should take. Biotechnology has been elevated into a social

phenomenon beyond the realm of science (Navarro, and Hautea, 2011). Liakopoulos (2002) says that biotechnology has become more of a social issue than a technological development. Ignorance may result in under-utilisation of the technology or abuse of it. One good example of the implications of advancement in science and technology is the completion of the Human Genome Project. With the successful completion of this megaproject, DNA-based tests will have the potential to form part of routine medical diagnostic and patient management strategies, and the results of these tests may impact on an individual's health insurance, life insurance and employment opportunities. Increasingly, DNA-based forensic evidence is used to solve cases of murder and rape, and to determine paternity disputes. Thus, the victim, the accused, the judiciary, lawyers, doctors and the police have a vested interest in understanding the technology. To be able to make informed decisions in the above mentioned cases and situations, the public need to understand the basics of genetics and the scientists need to understand the social implications, but only through effective science communication, education and public engagement that this can be achieved.

3. **Enable public to be involved in policy-making.** Dissemination of science too, enables the public to play a political role in society, once becoming science literate (Treise and Weigold, 2002). Only a well-informed populace will be able to contribute constructively towards new policies, regulations, and decisions (Borchelt, 2001). Highly controversial technologies require balanced input from the public to enable policy makers to develop research and industry-friendly policies and regulations, but at the same time taking into consideration the risks and concerns involved. For example, advancements and developments in gene

therapy, genetic modification, and cloning need to be regulated, but allowed to develop in a balanced manner to benefit society and the economy.

4. **Create market acceptance for new technologies and products.** The introduction of emergent technologies such as biotechnology, genomics and nanotechnology raise worries or fears among the general public, but also hopes and expectations (Bos et.al. 2009). An ignorant society may not only oppose a new technology due to fear of the unknown, but delay approvals and hamper the process of adopting a technology. This has the potential to drag the country behind in terms of research, development, and commercialization. For example, gene therapy, artificial wombs, cloning of organs, and much other advancement in science create fear and resistance among ordinary people. Bodmer (1985) says public's scientific ignorance might arouse fear and disfavour of science. Thus, various aspects must be communicated to the public to gain public confidence and acceptance, before the products or services reach the market, such as information on the technology, the risks and benefits, the measures taken to counter potential risks, the need for the technology, and the regulations and the guidelines that are in place.

5. **Development of human capital.** The other reason for communicating biotechnology is to inculcate interest in biotechnology among the younger generation who might otherwise not consider scientific careers (European Commission, 2002; and Treise and Weigold, 2002). This is crucial for developing countries as lack of skilled workers and researchers is one of the key challenges in creating a robust scientific community and biotechnology industry. Through effective science communication children could be encouraged to pursue careers in this field, providing more skilled workers and reducing the

dependence on foreign expertise and work force, as many developing countries are facing these problems and the consequences of lack of skilled workers in the field of biotechnology. A technologically literate society that is highly skilled can be a route to economic prosperity.

6. **Development of science literate policy makers and politicians.** It is also equally important for policy makers, decision-makers and politicians to be informed about biotechnology. Failure to communicate with politicians can cause increased mistrust and scepticism about science, and poor public policy making (Parsons, 2001). For example, policies, Acts, and regulations pertaining to genetic engineering, cloning, stem cell research, gene therapy, utilization of biodiversity, drug development, require a good understanding of biotechnology in order to make the best decisions. These areas are full of controversies yet could serve as solutions to many problems faced by mankind such as lack of food security, emerging diseases, and eroding biodiversity if the technology is allowed to advance while the risks are studied and addressed in a scientific manner. This will also ensure balanced and sound policies are adopted and implemented. An example is the formulation of Biosafety Act in Malaysia that governs genetically modified organisms. This is also the case for all countries that need to comply to the Cartagena Protocol of Biosafety (Secretariat of the Convention on Biological Diversity, 2000).

7. **Discriminating between scientists and "pseudo" scientists.** A science-literate public can also better distinguish between responsible and irresponsible science, and may better discriminate the activities of scientists from those of "pseudo" scientists (Miller, 2004; Shortland and Gregory, 1991). This is often seen in the field of modern biotechnology such as genetic modification, cloning,

xenotransplantation, synthetic biology, and stem cell technology, where "pseudo" scientists create fear among the public with scaremongering strategies using data that are not scientifically proven and verified. Any non-professional practice of science that is not shaped and constrained by the current norms and regulation of the academic community is labelled as pseudo-science (Bensaude-Vincent, 2001). However, lay public perspectives and their knowledge should not be construed as pseudo-science. Pseudoscience has been defined as "claims presented so that they appear scientific even though they lack supporting evidence and plausibility (Shermer, 1997). Demarcating pseudoscience and lay public knowledge is necessary and this could only be done by employing a good combination of communication models that not only aim at providing information and educating the public but also that listens to the public perspectives of biotechnology.

8. **Promote investment in biotechnology.** Lastly, a sound understanding of biotechnology among investors, bankers and venture capitals will ensure scientists and entrepreneurs receive funds and grants for commercialisation which will lead to a flourishing biotechnology-based industry. Funding is a major obstacle faced by entrepreneurs in biobusinesses as the gestation period is long and the risk of not creating a profitable business is very high. The investor community ideally should be able to understand research and technology for them to evaluate its potential and economic value.

1.3 THE PROBLEM STATEMENT

In order for Malaysia to see the fruition of her biotechnology-based policies, the level of biotechnology literacy should be enhanced and raised throughout the country. The interaction between scientists and the public must be increased for these two groups to understand each others concerns and views. The involvement of various stakeholders such as scientists, academia, policy makers, politicians, members of the media, consumers, farmers, industries, legislators, and religious authorities, who are all involved in the development of biotechnology makes biotechnology communication a complex issue. This is coupled with the fact that biotechnology remains very much in the domain of scientists. In early modern science, most educated people could understand the writings of scientists such as Copernicus and Galileo, but by 1687, Isaac Newton's *Philosophiae Naturalis Principia Mathematica* could be understood only by specialists. According to Mitsuishi et.al. (2001), this was the beginning of when science began to be inaccessible to non-specialists.

In the twentieth century science was increasingly divided into a variety of fields, each developing separately and intensely. It became compartmentalised and specialised and showed a tendency to segregate within the specialist community. This resulted in science becoming difficult to understand for both lay people and specialists in other fields. Thus, science fell into its current condition of being closed off internally from other scientists, and externally from the public (Mitsuishi et.al., 2001). Biotechnology is no exception and shares the same fate as science in general.

Many policies in Malaysia such as the National Biotechnology Policy (Ministry of Science, Technology and Innovation, 2005), the Third National Agriculture Policy (Ministry of Agriculture and Agro-based Industry, 1998), the Ninth Malaysia Plan (Economic Planning Unit, 2006), and our education policies, heavily hinge on the development of science, especially biotechnology. Much efforts and resources are being allocated to ensure Malaysia attains the developed nation status by the year 2020, along with aspirations to create a Nobel Laureate by that year (Academy of Sciences Malaysia, 1998), and to make Malaysia a major global biotechnology player.

Under the National Biotechnology Policy (Ministry of Science, Technology and Innovation, 2005), biotechnology is expected to contribute 2.5 per cent to Gross Domestic Product (GDP) by 2010, four per cent by 2015, and five per cent by 2020. The investment in this field by 2020 is expected to grow up to RM30 million and create 280,000 jobs. More than 100 biotechnology-based companies are to be established which would generate a revenue of RM625 million, with a compounded annual growth rate of 23.7 per cent.

Notwithstanding the need to achieve these objectives under various national policies, Malaysia also has an obligation to involve the public in decision making related to many biotechnology advances, particularly Living Modified Organisms (LMOs) or genetically modified organisms (GMOs). As a party to the Cartagena Protocol on Biosafety (Secretariat of the Convention on Biological Diversity, 2000), Malaysia is urged to promote and facilitate public awareness and public participation regarding activities related to the protocol and products of modern biotechnology (Secretariat of the Convention on Biological Diversity, 2000).

However despite the prominence that the biotechnology sector is accorded by the government, there are no serious efforts to enhance public understanding of biotechnology in Malaysia. A search on speeches made by ministers in Malaysia since the launch of the National Biotechnology Policy in April 2005 till Dec 2010 showed there has been no mention about science or biotechnology communication. One exception is the speech made by Chief Minister of Sabah, Datuk Chong Kah Kiat at the International Conference on Public Understanding of Science and Technology 2001 in Sabah. Datuk Chong said,

> *"We are fully aware that there is still a large gap or disparity in our society between those in scientific and technical professions and those in other areas…. As a result, there is an urgent need for us to establish and strategise the best channels of communication in promoting science and technology. In essence, we need to find the best ways to communicate with the masses, to inform the layman of the important role science and technology plays in our daily lives" (Chong Kah Kiat, 2001).*

However, there were no policies or initiatives from the government on this issue. In contrast, the Royal Society's Bodmer Report (1985) in the United Kingdom gave rise to a number of studies on science literacy of the British population and outlined measures to enhance public understanding of science, including biotechnology. The role of scientists in communicating science to the public was further exemplified by the Wolfendale Committee in 1995 in UK, addressing scientists who receive grants from public funds, which also includes the field of biotechnology. This Office of Science and Technology report was chaired by former Astronomer Royal, Sir Arnold Wolfendale. The committee's recommendations included proposals designed to build public understanding into its Research Council's grant procedures and concluded that (Wolfendale Committee, 1995):

> *"In principle, all who receive grants from public funds should accept responsibility to explain to the general public what the grant is enabling, or has enabled them, to do and why it is important and how it fits into the broader area of knowledge."(Wolfendale Committee, 1995)*

The Select Committee on Science and Technology (2000) reported that fifteen years since the Bodmer report, there has been a cultural change in the attitude to outreach activities in the UK. Such activity is no longer seen, except by a dwindling minority, as beneath the dignity of a researcher. Public understanding activities received £4.5 million per year from the budget of the Office of Science and Technology. There is now a large academy community within social science devoted to the study of the public understanding of science and of the impact of science outreach activities, with a substantial literature.

Such a roadmap for biotechnology communication is crucial for Malaysia and would lead to more scientists being involved in this area, and to a more coherent effort by all players involved such as the scientists, media, communication or public affairs officers at research institutes and universities, and government agencies to achieve biotechnology literacy among the public and for the scientists and the government to understand public concerns and views. This should take into account both the deficit model and contextual approach and adapt it according to local needs.

A number of studies shows that media is the main source of scientific information for the lay public (Barns, 1989; LaFolette, 1990; Metcalfe and Gascoigne, 1995; and Nelkin, 1995). However, the media in Malaysia does not play a key role in communicating biotechnology. Science and in particular biotechnology is not a prominent area as media lacks trained journalists in science or a dedicated science desk.

This study attempts to address the void in proper biotechnology communication strategies, and framework; and the lack of understanding of public attitudes, interests and needs among biotechnology communicators, and the challenges faced in communicating biotechnology by the various biotechnology communicators. The findings from this research would lead to the development of a national biotechnology communication framework. This would possibly ensure harmonisation among the current biotechnology communication strategies and lead to fostering understanding and appreciation of biotechnology among the publics and also encourages participation of various stakeholders. Creating such an environment is crucial for a country like Malaysia that in investing tremendous amount of money and time in the biotechnology industry, research and development.

1.3.1 The Research Scope

As the areas studied in this research are new and there are no previous studies that map the entirety of biotechnology communication in Malaysia (its players, public attitudes, issues and influences), this research has taken a broad spectrum approach, seeking to analyse all these areas. This research sets the groundwork in mapping the biotechnology communication matrix in Malaysia and provides baseline information on the various biotechnology communicators, their strategies and public attitudes. It is important that all aspects of biotechnology communication in Malaysia are mapped to provide a good understanding of the entire framework, the individual components and how they relate to each other. The findings from this research should provide a starting point for further in-depth research into individual components of biotechnology communication (e.g. media, scientists, public affairs officers, religious scholars, or the different categories of the publics) for future research.

1.3.2 Research Questions

Research Question 1: What is the role played by biotechnology communicators in Malaysia, their objectives, target audience, strategies, and challenges?

Research Question 2: What are public attitudes and interests towards biotechnology, sources of information, preferred media and perception of credibility of biotechnology communicators?

Research Question 3: Do the current biotechnology communication strategies employed by communicators meet the needs of the public?

Research Question 4: How can we adapt biotechnology communication strategies and approaches in the UK, USA, Australia, Singapore and the Philippines for local needs? Are the strategies in these countries better than that in Malaysia?

1.4 HYPOTHESIS

This study is conducted based on the following hypothesis:

(i) Despite biotechnology being a priority technology in Malaysia, biotechnology communication is not a priority among scientists, policymakers and the media.

(ii) There is neither national policy nor champions to spearhead biotechnology communication in Malaysia.

(iii) There are no coherent nor coordinated efforts among the various biotechnology communicators.

(iv) There is a lack of understanding of the public attitude, their information needs and interest among biotechnology communicators.

1.5 OBJECTIVES OF THE STUDY

(i) To identify existing biotechnology communication activities in Malaysia in terms of players involved, their objectives, strategies, challenges and shortcomings

(ii) To identify the components of public attitudes and interests toward biotechnology.

(iii) To identify suitable biotechnology communication strategies for Malaysia based on the practices in Singapore, USA, UK, Philippines, and Australia

(iv) To propose a biotechnology communication framework and strategy for Malaysia

1.6 DEFINITIONS FOR THE SCOPE OF THIS STUDY

1.6.1 Biotechnology

Although science communication is a wide discipline which covers all gamuts of sciences such as physics, chemistry, biology, biotechnology, medical and healthcare, nutrition, and astronomy among others, this study only focuses on communicating biotechnology. Biotechnology is defined by the International Service for the Acquisition of Agri-Biotech Applications (ISAAA, 2006) as:

> *"Any technique that makes use of organisms or parts thereof to make or modify products, to improve plants or animals, or to develop microorganisms, for specific purposes."(ISAAA, 2006)*

1.6.2 Science Literacy

The definition for science literacy could also be used to define biotechnology literacy. Hazen (2002) defines science literacy as a mix of concepts, history, and philosophy that help us understand the scientific issues of our time and is rooted in the most general scientific principles and broad knowledge of science; the scientifically literate citizen possesses facts and vocabulary sufficient to comprehend the context of the daily news. According to Greenfield (2003), the only way to evaluate the implications of science is to be scientifically literate, and one can only be scientifically literate if one is willing to have an open mind and stop expecting our scientists alone to be the scientific conscience of the nation.

Nisbet (2005) identifies five important dimensions to an "understanding of science":

1. **Practical scientific literacy:** refers to knowledge that can be applied to solving common everyday personal problems such setting their VCRs, repairing household appliance or automobile. Although many scientists and institutions deem this dimension of knowledge important, it is not the typical focus when they engage in public understanding activities.

2. **Civic science literacy:** means a level of understanding of scientific terms and constructs sufficient to make sense of a news report, and to interpret competing arguments on a complex policy matter. Miller (1998) measured civic science literacy in surveys by asking respondents a series of questions that tap their understanding of basic scientific facts, such as the definition of DNA or a molecule, or whether the respondent can correctly identify as either true or false that the "centre of the earth is very hot", or that "antibiotics can kill viruses as well as bacteria".

3. **Institutional science literacy:** focuses on the politics of science. For example, who funds and regulates scientific research in a country? How is controversial science such as cloning regulated? How does peer-review work? Does science inform policymaking? Can a citizen identify the leaders of major scientific institutions? It is likely that when something goes wrong with science, such as a highly visible case of fraud, unethical conduct or corruption, citizens with a better understanding of science as an institution are more likely to attribute the episode to a complex set of political and social factors, rather than to the bad character of the institution or of scientists as a group (Sturgis and Allum, 2004).

4. **Low information rationality:** is a term that questions both the ability and the motivation of the public to be knowledgeable about science. In the case of newly emerging science controversies such as those over embryonic stem cell research, it is unlikely given the many competing events in the worlds, that the public will hold a great deal of issue-specific knowledge. Instead the public makes up for a lack of information by relying heavily on their individual value predispositions such as religion and ideology (Nisbet, M, 2005).

5. **Social context emphasis:** highlights the contingent influence of social identity and trust on how information about science is used by the public. Wynne (1992) argues that the way a particular social group is likely to use scientific knowledge varies by how that group interprets the motivation of scientists and their institutions. For example, in the case of genetically modified (GM) food, a Green Party member in Europe is likely to interpret the information provided by a Monsanto scientist very differently than if the same information were provided by a government scientist.

1.6.3 Biotechnology Communication

Biotechnology communication has not been specifically defined in any previous studies, thus, the term science communication is used as a reference. The most common terms used are public awareness of science, public understanding of science, scientific literacy, and scientific culture. Burns et. al. (2003) suggest that these terms should not be used interchangeably, though considerable commonality does exist between them. The definitions according to Burns et. al. are as following:

- Public awareness of science aims to stimulate awareness of, and positive attitudes (or opinions) towards science.
- Public understanding of science, as the name suggests, focuses on understanding of science: its content, processes, and social factors.
- Scientific literacy is where people are aware of, interested and involved in, form opinions about, and seek to understand science.
- Scientific culture is a society-wide environment that appreciates and supports science and science literacy. It has important social and aesthetic (affective) aspects.

The 2000 report by the UK Office of Science and Technology and Wellcome Trust (Science and the Public. A Review of Science communication and Public Attitudes to Science in Britain) identifies the existence of key communication between the following groups:

1. Groups within the scientific community (including those in academia and industry),
2. The scientific community and the media,
3. The scientific community and the public,
4. The scientific community and the government, or others in positions of power and authority,
5. The scientific community and the government, or others who influence policy,
6. Industry and the public,
7. The media (including museums and science centres) and the public, and
8. The government and the public.

This study uses the definition given by van Dijck (2003) for science communication where it implies reciprocity among all agents involved and dismisses the existence of an implicit hierarchy between the experts and the ignorant.

Another relevant definition of science communication is: ‘the use of appropriate skills, media, activities and dialogue to produce one or more of the following personal responses to science: awareness, enjoyment, interest, opinion-forming and understanding’ (Burns et. al., 2003). A combination of both these definitions would substantially contribute towards a more scientific literate society. The duty of scientists is not to educate the public, but rather to interact with it. The public is the true driving force behind decisions with social consequences, and must be involved on an equal basis in debates about them (Libutti and Valente, 2006). Another concept introduced by Kim (2007) which is very relevant to this study, is public engagement with a problem or an issue relative to science (PEP/IS). It starts with the publics’ point of view and not solely as communication receiver. This contrasts with the information producer’s point of view, on which is a traditional notion of science popularisation, scientific literacy, or public understanding of science is based.

Stocklmayer et. al. (2002) says learning about science can occur in either formal or informal settings. Science education at primary, secondary and tertiary levels is considered formal and learning about science at science centres, museums, theatres, and conferences and exhibitions is labelled as informal. For many people exposure to science tends to occur after completion of their formal education, through informal channels which play a key role in enhancing their understanding of science (Treise & Weigold, 2002).

Using the definitions outlined above, the best practice and model proposed in this study seeks to pave a way for scientists to interact with the public which will enable both these groups to understand each others' concerns and create a more scientifically literate society.

1.6.4 Key Biotechnology Communicators

The key biotechnology communicators identified for this study are:

- Scientists
- Policy makers (in ministries)
- Mediators (public relation officers at research institutes, and science communicators at organisations involved in biotechnology communication)
- Members of the media
- Religious scholars (Muslim, Hindu, Buddhist, Christian, Tao, and Sikh)

Scientists: For the purpose of this study, 13 scientists from four research universities, four research institutes and two private companies were interviewed. The research universities are University of Malaya (UM), Universiti Sains Malaysia (USM), Universiti Kebangsaan Malaysia (UKM), and Universiti Putra Malaysia (UPM), whereas the research institutes are Malaysian Agricultural Research and Development Institute (MARDI), Forest Research Institute Malaysia (FRIM), Malaysian Palm Oil Board (MPOB), and Malaysian Rubber Board (MRB). The two private companies are Sime Darby and BioSatria.

Policy makers: Two prominent ministries involved in biotechnology communication were identified; the Ministry of Science, Technology and Innovation (MOSTI) and the Ministry of Natural Resources and Environment (NRE). Two policy makers from these ministries were interviewed.

Public Affairs Officers: Public relation officers from MARDI, FRIM and MRB were interviewed on their role as biotechnology communicators.

Non-Research Organisations: Six representatives from Academy of Sciences Malaysia (ASM), Institute for Islamic Understanding Malaysia (IKIM), Malaysian Biotechnology Corporation (BiotechCorp), Malaysian Biotechnology Information Centre (MABIC), and the National Science Centre (NSC) were interviewed. For ease of reference, these organizations are termed as Non-Research Organisations (NROs) as they are not involved in conducting research.

Members of the media: Seven journalists were interviewed in this study encompassing those from print media which covers journalists from Malay and English newspapers.

Religious scholars: Religions play an important role in the life of Malaysians and scholars enjoy high credibility among all communities. They are the referral point to clarify controversies in science that is related to ethics and permissibility in any religion. In-depth interviews were conducted with six religion representatives from different faiths: Islam, Hindu, Buddhist, Christianity, Taoism, and Sikhism.

1.6.5 The Publics

The simplest and most useful definition of the public is every person in society (Burns, et. al., 2003). However, these authors acknowledged that “the public” is a very heterogeneous group with diverse needs, interests, attitudes and level of knowledge. The sectors chosen as respondents are a good reflection of the general population of Malaysia who make up the majority of potential biotechnology information seekers and target groups for biotechnology communication and engagement. With religious scholars, there is an overlap between being biotechnology communicators and the public, where they play a role as communicators but at the same time they are also recipients of biotechnology information. Thus, their in-depth interview questions cover both areas. The following groups are studied:

- Secondary school students (A good mix of rural and urban school students were included for this survey)
- Undergraduates (respondents were from both public and private universities)
- General public (people from all walks of life, age group, race, socioeconomic and education background were approached to participate in the survey. This was carried out in shopping malls, science events, offices, train stations and neighbourhoods). Attentive public who attended MyBio Carnival were also included to give a better reflection of the diversity of the publics.
- Teachers (from different states in Malaysia, which includes both rural and urban states)

1.7 METHODOLOGY

As this research attempts to identify biotechnology communicators, their role and activities, and to propose a best practice and biotechnology communication model for Malaysia, the following information needs to be known:

- The various players who are involved in communicating biotechnology, and their objectives, target audiences, strategies, constraints, and challenges must be identified.
- Public interest in biotechnology, preferred and trusted source of information, motivation to understand biotechnology must be determined,
- The impact of MyBio Carnival as a non-traditional approach in communicating biotechnology. MyBio Carnival is a non-traditional approach that incorporates biotechnology into school competitions, fashion shows, exhibitions for the public, and interactive sessions. It was organised by the Malaysian Biotechnology Information Centre (MABIC) and Malaysian Biotechnology Corporation (BiotechCorp). Participants ranged from scientists, industry, students, media, and general public. More details of the carnival is provided in Chapter 4.
- Media coverage of biotechnology issues, source of news, importance given to biotechnology should be examined, and
- Successful biotechnology communication strategies from countries such as the UK, USA, Australia, Singapore and the Philippines are studied as models.

The following methods are employed to achieve the stated objectives. These methods are briefly explained under each objective below. More detailed methodology is provided in the Methodology Chapter.

i) Media monitoring
ii) In-depth interviews
iii) Surveys carried out among the public (general public, attentive public who attended MyBio Carnival, teachers, secondary school students, and undergraduates)
iv) Case study of MyBio Carnival
v) Literature review encompassing country reports and published papers on science and biotechnology communication strategies

Objective 1: To identify existing biotechnology communication activities in Malaysia in terms of players involved, their objectives, target audience, success, challenges and shortcomings

The role of the following biotechnology communicators and their activities, objectives, challenges and shortcomings were studied:

i) Media
ii) Scientists
iii) Public affairs officers at research institutes
iv) MABIC (Malaysian Biotechnology Information Centre)
v) Malaysian Biotech Corporation (BiotechCorp)
vi) National Biotechnology Division, Ministry of Science, Technology and Innovation (BIOTEK)

vii) Department of Biosafety, Ministry of Natural Resources and Environment (NRE)

viii) National Science Centre (NSC)

ix) Academy of Sciences (ASM)

x) Institute for Islamic Understanding Malaysia (IKIM)

Media monitoring was carried out on six main newspapers based on textual analysis for three months, to study:

a. Frequency of science news
b. Percentage of biotechnology news compared to other science fields
c. Source of information for journalists

This provided the information on the importance accorded by journalists and editors to biotechnology news and their communication with scientists to source the news. Follow-up in-depth interviews were carried out with journalists and editors to discuss the results obtained from media monitoring, to further understand their role, attitude and objectives towards biotechnology communication.

In-depth interviews were also conducted with scientists and the person-in-charge of communication in each of the above mentioned organisations. Religious scholars from various faiths (Islam, Hindu, Buddhist, Christianity, Taoism and Sikhism) were also interviewed.

Objective 2: To identify the components or elements of public attitude and interest towards biotechnology

To achieve this objective, surveys were conducted with school and university students, the general public, and teachers. School students from different backgrounds (science and arts) were included in this survey. University students were chosen from different local and private universities, and teachers from rural and urban schools were part of the survey. The survey provided information on their preferred media, their perception on the credibility of information sources, and their interest level in biotechnology, and level of knowledge.

A case study on MyBio Carnival 2010 was then undertaken to evaluate this event as a non-traditional approach to engage the public. This was important to understand the strategies that would be effective in engaging the public as the general public is not a popular target audience among scientists and other biotechnology communicators. The attitudes, needs and level of knowledge of attentive audience would enable the development of a communication framework that would be inclusive and takes into account the heterogeneity of the publics.

Objective 3: To identify suitable biotechnology communication for Malaysia based on the practices in Singapore, USA, UK, Philippines, and Australia

To achieve this objective, in-depth interviews were conducted with players from other countries, namely the United Kingdom, the United States of America, Australia, Singapore and the Philippines. Information was also gathered from literature reviews and reports. This helped benchmark Malaysia’s biotechnology communication efforts currently practiced and also provided an insight into what could be adopted and adapted for Malaysia.

Objective 4: To Propose a Framework for National Biotechnology Communication Strategy in Malaysia

A framework for national biotechnology communication strategy was developed based on the public needs, interests, attitudes and also the objectives and strategies of the communicators, and their target audiences. Experiences from the countries studied in this research were adapted where necessary and appropriate. Components of non-traditional approach from MyBio Carnival were incorporated to engage the general public.

A more detailed methodology is explained in Chapter 3.

1.8 LIMITATIONS OF THE RESEARCH

There were no previous studies that mapped all the biotechnology communicators and their communication strategies in Malaysia with a comparison to the needs, interest and level of knowledge of the publics. Thus, there were no references that could lead to in-depth study in this area. Additionally, public attitudes and perception towards biotechnology were studied with the lack of understanding of the impact and influences of biotechnology communication initiatives and strategies. In view of these limitations, this study attempted to provide a baseline data on both the public and biotechnology communicators, that would enable the development of a framework for national biotechnology communication strategy. Only a small number of scientists at universities and research institutes in Malaysia are involved in public understanding of biotechnology, thus, the sample size for the in-depth interview was very small. However, the respondents were carefully selected after consultation with MABIC and BiotechCorp (the two organisations that engages scientists in their biotechnology communication initiatives) based on their involvement in this area to ensure their opinions best reflect the current biotechnology communication practices. This study covers all agencies involved in biotechnology communication, the key personalities at universities and research institutes, and major segments of the public. Thus, it provides a broad-based scope and findings that would lead to identification of issues and problems at each intersection of biotechnology communication in Malaysia. Findings from this study would enable future research to explore each area of biotechnology communication in a more detailed and in-depth manner and also testing of the hypothesis proposed in this thesis.

Because of language barrier, the Chinese newspapers in Malaysia were not analysed as a part of media monitoring. However, the selected newspapers are likely to represent the dominant tone of coverage in Malaysia and provided strong indicators of the tone of coverage, the focus area, interaction between scientists and the media, the source of news, and frequency of science news. The other limitation was that the electronic media (television and radio) was not covered. This was due to the fact that there are very few programmes dedicated to science, especially biotechnology. Science subjects are sometimes covered in some general talk shows and other documentaries, which made monitoring science news on air very difficult. Furthermore, electronic media seriously lack biotechnology programmes and emphasis is given to either basic agronomic practices and medical issues (health and disease management) with no components of biotechnology.

References on religious scholars as biotechnology communicators are lacking, as there are no previous studies on the topic. In the entire thesis, literature on science communication is used as reference to biotechnology communication as the principles and the challenges are often the same.

1.9 CONCEPTUAL FRAMEWORK

The research carried out to produce this thesis is summarised in Figure 1.0 in the form of a conceptual framework. The conceptual framework includes the respondents and players involved in this research, the areas and issues covered, and how the framework for national biotechnology communication strategy in Malaysia is derived. In short, Figure 1.0 shows the entirety of this research in a diagrammatic approach.

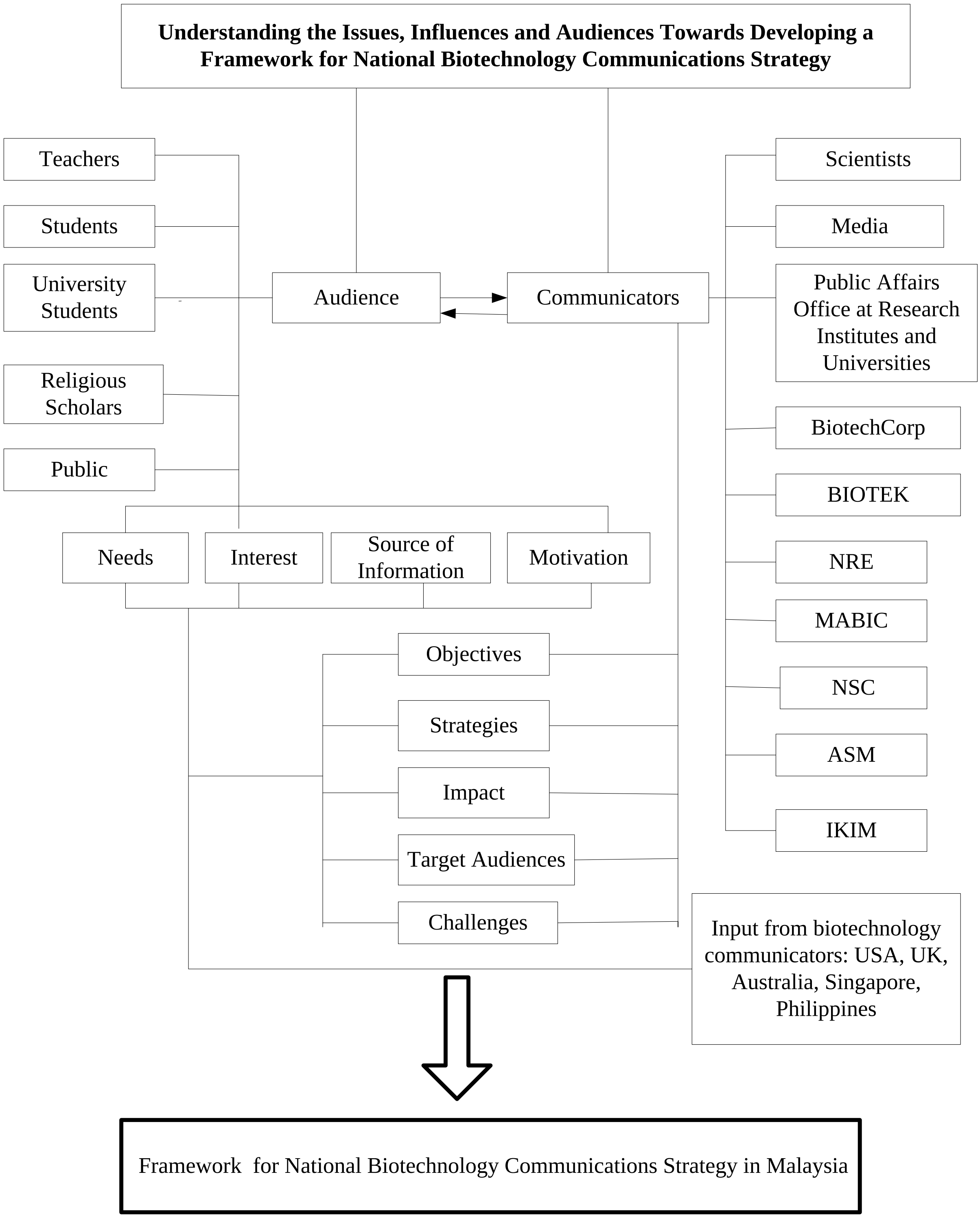

Figure 1.0: Conceptual Framework