Malaysian Journal of Environmental Management 6 (2005): 73 - 86

Relationship between General Attitude towards Nature, Religion, Custom, Science and Technological Progress and Attitude towards Modern Biotechnology

LATIFAH AMIN[1], JAMALUDDIN MD. JAHI[2], ABD RAHIM MD. NOR[3], MOHAMAD OSMAN[4] & NOR MUHAMMAD MAHADI[4]

ABSTRACT

Modern biotechnology has been classified as a complex emerging issue that exhibits high salience combined with limited knowledge on part of the public. It has been suggested by social scientists that any complex object may be located in a variety of general classes where its evaluation may be strongly affected by extraneous concerns. The purpose of this paper is to analyse the relationship between several general classes of attitudes and attitude towards genetically modified soybean as an example of modern biotechnology product available in Malaysia. A survey was carried out on 991 respondents from various interest groups in the Klang Valley region. Results of the survey have confirmed that attitude towards complex issues such as biotechnology should be seen as a multi-faceted/multidimensional process. The most important factors predicting encouragement of GM soybean are the specific application-linked perceptions about the benefits, acceptance of risk and moral concern while risk and familiarity are significant predictors of benefit and risk acceptance. Attitude towards GM soybean is also predicted by several general classes of attitude such as general promise and concern of biotechnology, technology optimism, nature/materialistic value, predisposition towards science and technology, attachment to religion and custom. Researchers, policy-makers and industries interested in developing and marketing GM products in Malaysia should consider the various factors mentioned in this study in order to gain public approval.

ABSTRAK

Bioteknologi moden telah dikelaskan sebagai satu isu kompleks baru yang amat menonjol tetapi sukar difahami oleh masyarakat awam. Ahli sains sosial mencadangkan bahawa sebarang perkara yang kompleks mungkin terletak dalam pelbagai kelas umum dimana penilaian mengenainya turut dipengaruhi oleh faktor-faktor tambahan lain. Tujuan artikel ini adalah untuk menganalisis hubungan antara beberapa kelas umum sikap dan sikap terhadap kacang soya terubah suai secara genetik sebagai contoh produk bioteknologi moden yang terdapat di Malaysia. Satu kajian telah dijalankan ke atas 991 orang responden

daripada pelbagai sektor masyarakat di kawasan Lembah Klang. Hasil kajian mengesahkan bahawa sikap terhadap isu kompleks seperti bioteknologi patut dilihat daripada pelbagai sudut/dimensi. Faktor peramal paling utama kepada sokongan terhadap kacang soya GM adalah persepsi mengenai faedah, penerimaan risiko dan aspek moral sementara faktor risiko dan 'familiarity' adalah peramal yang signifikan kepada faedah dan penerimaan risiko. Sikap terhadap kacang soya GM turut diramal oleh beberapa kelas umum sikap seperti faedah dan kerisauan umum mengenai bioteknologi, optimisma terhadap teknologi, nilai alam semula jadi/kebendaan, tanggapan mengenai sains dan teknologi dan kekuatan pengaruh agama dan adat. Para penyelidik, pembuat dasar dan industri yang berminat untuk membangunkan dan memasarkan produk GM di Malaysia sepatutnya mengambil perhatian terhadap faktor-faktor yang telah dinyatakan.

INTRODUCTION

Biotechnology has been identified as one of the five core technologies that will accelerate Malaysia's transformation into a highly industrialized nation by 2020. Research and Development (R&D) activities are categorized into seven sectors: namely plant, food, animal, molecular biology, medical, bio-pharmacy and industrial/environmental biotechnology (BIOTEK 2002). Almost all researches in modern biotechnology in Malaysia are still at the experimental stage except for papaya, modified for delayed ripening, which are already undergoing contained field trial. Although modern biotechnology products developed by Malaysian researchers are not being commercialized yet, modern biotechnology products from other countries are slowly coming in. The only agricultural product/food already officially available in the Malaysian market is Glyphosate resistant soybean for human consumption. Besides soybean, four types of genetically modified corns meant for human food and animals' feed have been submitted by Monsanto to the Ministry of Science and Technology for market approval (Adib 2004). Another 26 biopharmaceuticals produced using modern biotechnology techniques were already registered with the Ministry of Health Malaysia (MOH) for use in this country. The list ranging from different types of insulin for the treatment of diabetes, growth hormones, drugs for the treatment of various kinds of cancers, hepatitis, infertility, autoimmune disorders, organ transplant and infectious diseases.

The advancement in modern biotechnology have been so rapid in the past ten years, it has been the object of an intense and divisive debate in advanced countries. Sagar et al. (2000), suggest that a major factor in the emergence of controversies surrounding biotechnology has been the neglect of the needs, interests and concerns of the primary stakeholders –

the commoners. Public perceptions, understanding and acceptance of GMOs can both promote and hamper commercial introduction and adoption of new technologies (Kamaldeen & Powell 2000). Various studies have shown that consumer acceptance of modern biotechnology tend to be conditional and dependent on several factors.

Public acceptance can be understood as the combined attitude of individuals on certain political issues, such as those arising from technological innovations (Aerni 1999). An individual's attitude towards a new technology depends on his (or her) perception of its risks and benefits, his socially communicated values and trusts in institutions representing these technologies. Other studies also concluded that the public's main concerns about biotechnology are primarily driven by ethical, value and safety concerns (Einsiedel 1997). Gaskel et al. (2000) used four dimensions of attitude: perceived use, risks, moral acceptability and encouragement to model patterns of European public response to biotechnology.

The studies of public attitude towards biotechnology have many similarities with risk perception studies where the concept of 'risk' and 'attitude towards complex issues' such as biotechnology should be seen as a multi-faceted/multidimensional construct. The key variables of risk perception research are the perceived magnitude of risk or dread, risk acceptance, familiarity with the hazard and lately the factor benefit has gained much interests (Rohrmann 1999).

Modern biotechnology has been classified as a complex emerging issue that exhibits high salience combined with limited knowledge on part of the public. It has been suggested by social scientists that any complex object may be located in a variety of general classes where its evaluation may be strongly affected by extraneous concerns (Pardo et al. 2002). From the perspectives of several earlier researchers, attitudes towards biotechnology would be expected to follow from the more general class of attitudes to which they pertain: predispositions towards science and technology in general. They may also be related to attitudes towards the natural environment, technological progress, towards religious and moral beliefs and several other sets. According to the review by Rohrmann (1999), the evaluative process of risk perception is determined by the norms, value systems and cultural idiosyncrasies of societies. He included eco-centric worldview, technology skepticism and safety culture in his model as well as risk-taking attitude. Gaskel et al. (2003) also found out that certain general value orientations were associated with different level of support for biotechnology. Those who are more concerned about nature are less optimistic about biotechnology, while those espouse materialistic values are more optimistic. It is the purpose of this paper to analyse the relationship between several general

classes of attitudes and risk/benefit perception of modern biotechnology in Malaysia.

METHODOLOGY

Survey Data Collection

This is one of the first in-depth study on attitude towards modern biotechnology in Malaysia. The people in the Klang Valley region were chosen as the targeted population as it is the centre of country's economic and social development (numerous existing universities and R&D institutions, biotechnology related industries) besides the respondents in this region meet the requirement of diverse background stated in the model.

In this study, a wider range of interest groups including producers, scientists, policy-makers, NGOs, media, politicians, religious experts, university students and general public were surveyed. They were chosen using multi-stage sampling technique. The respondents (n=991) were adult representatives (age 18 years old and above) from various interest or stakeholders groups mentioned earlier. Each stakeholders group will have a minimum target sample of 40 respondents except for the general public. Since the majority of the Klang Valley residents comprised of the general public, this group was allocated 550 respondents. The general public was further stratified according to their occupations classification by Malaysian Standard Classification of Occupations 1998 (MASCO). The ratios for different gender, races and religion of the residents in the Klang Valley were also taken into account.

Using the approach recommended by Kelley (1995) to carry out a base-line study in Malaysia, the respondents were first introduced to the basic concepts of modern biotechnology. The questionnaires were administered face to face to the respondents.

Instrument

The multi-dimensional attitude towards biotechnology instrument used in this study was self constructed based on earlier researches (Latifah et al. 2004). The instrument incorporated six dimensions of attitude towards genetically modified soybean (resistant to herbicide): perceived benefits, perceived risks, encouragement, familiarity, moral concerns and risk acceptance. General classes of attitude included general promises and general concerns of modern biotechnology, nature/material value, technology optimism, predisposition towards science and technology, religious and custom attachment.

Perceived benefit scale (α=0.87) comprised of seven items: benefit to Malaysian society, enhance quality of product, enhance quality of life,

enhance Malaysian economy, benefits exceed risks, safe to consume/use and acceptable by religion. Each item was measured on a 7-point scale, ranging from 1(not useful at all for item 1/ strongly disagree for the other items) to 7 (very useful for item 1/ strongly agree for the other items). A higher score indicates higher perceived benefit.

The measure for perceived risk (α=0.82) was obtained by using five items: feelings of anxiety, harm to health, long term effect, catastrophic potential and overall risk magnitude. Each item was measured on a 7-point scale, ranging from 1 (not worried at all for the first four items/ no harm at all for the last item) to 7 (very worried for the first four items/very harmful for the last item). A higher score indicates higher perceived risk.

Encouragement (α=0.88) was measured by four items: more rigorous research and development, should be commercialized, should be given monetary support by government and overall encouragement. Each item was measured on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher score indicates higher encouragement.

Familiarity (α=0.72) comprised of four items: easy to know, easy judgement, effect known and controllability. Each item was measured on a 7-point scale, ranging from 1 (not easy at all for the first two items/ strongly disagree for the remaining two items) to 7 (very easy for the first two items/ strongly agree for the other items). A higher score indicates greater familiarity.

Moral concern (α=0.81) was assessed by asking the respondent three questions related to whether the application threaten natural order of things, likened as 'play God" and regarded as co-modifying life. Each item was measured on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher score indicates higher moral concern.

Measure for risk acceptance (α=0.72) comprised of three items: accept risk if it can boost Malaysian economy, societal risk acceptance and risk minimal in comparison with other risks. Each item was measured on a 7-point scale, ranging from 1 (not willing at all for the first item/ not acceptable for the second and strongly disagree for the last item) to 7 (very willing for the first item/very acceptable for the second item and strongly agree for the last item). A higher score indicates higher risk acceptance.

For the general promise of modern biotechnology (α=0.87), five items were included: modern biotechnology has the potential to contribute to Malaysian agricultural sector, good for Malaysian economy, cure serious diseases, enhance quality of food and useful in the fight against third world hunger. Each item was measured on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher score indicates higher promise.

General concern of modern biotechnology (α=0.89) was measured by six items: modern biotechnology products might be harmful to health, harmful to the environment, worry to consume, harmful to future generations, worry about sanctity values, and unnatural. Each item was measured on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher score indicates higher concern.

Nature/materials value (α=0.78) was assessed by asking the respondents to state their preferences on five bipolar statements concerning nature and materials value. Each item was measured on a 7-point scale, ranging from 1 (strongly preferred nature value) to 7 (strongly preferred material value). A higher score indicates higher material value.

Predisposition towards science and technology (α = 82) was measured by four statements describing the impact of science and technology on humanity and nature. Each item was measured on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher score indicates higher negative predisposition towards science and technology.

The measure for technology optimism (α=0.59) was obtained by asking the respondents their agreement on the usefulness of five technology to improve their way of life (tend to agree = 1, tend to disagree = 2, don't know = 3). Responses to these five items were recoded, tend to agree was given a score of 1 while tend to disagree or don't know were given a score of 0. The scores for the five items were then totalled up. A higher score indicates higher technology optimism.

Religious attachment (α = 0.95) comprised of five items involving the importance of religion and religious rites in the respondents' life. Each item was measured on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher score indicates higher religious attachment.

Custom attachment. (α = 0.85) was assessed by asking the respondents three items on the importance of societal customs and traditional values and ceremony in their everyday life. Each item was measured on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher score indicates higher custom attachment.

Statistical Analysis

Initially, reliability tests and confirmatory factor analysis were carried out using SPSS version 12.0 to assess the consistency and uni-dimensionality of the constructs. Then correlational analyses were carried out at a bivariate level followed by structural equation modelling (SEM) analyses using AMOS version 5.1 to test the interrelationships among all variables which correlated at the bivariate level (Brathwaite &Ahmed 2004).

RESULTS AND DISCUSSIONS

Confirmatory Factor Analysis and Reliability

Confirmatory factor analysis (CFA) was carried using SPSS version 12.0 to assess the construct validity. CFA yielded 12 factors with eigenvalues greater than 1.0, with all items having a loading of 0.5 and above. The loadings were considered very significant (Hair et al. 1992). Technology optimism was not included in CFA analysis as the measurement used was dichotomous. Cronbach's coefficients for all constructs were greater than 0.7 indicating good reliability except for technology optimism which has an α value of 0.6, which is still acceptable according to Sekaran (1992).

Correlational Analysis

In order to examine the relationships among the general attitudinal and attitude towards genetically modified soybean (GM soybean) constructs at a bivariate level, Pearson correlations were carried out. From Table 1, it can be seen that there are significant correlations between the dimensions of attitude towards GM soybean. Attitude towards GM soybean construct consisted of six dimensions: familiarity, moral concerns, risk, risk acceptance, benefit and encouragement. Familiarity was found to be positively correlated to benefit, risk acceptance and encouragement of GM soybean while moral concerns and risk aspects of GM soybean were positively correlated to each other but were negatively correlated to all other dimensions of attitude except familiarity. The remaining two dimensions: benefit and risk acceptance were found to be positively correlated with each other and also with encouragement.

The relationships between general attitudinal constructs: general promise and general concerns of modern biotechnology, technology optimism, nature and post-material values, predisposition towards science and technology, attachment to religion and custom and attitude towards GM soybean were also displayed in Table 1. Respondents who believed in the general promises of modern biotechnology were found to perceive GM soybean as more familiar, of low moral concerns and risks, if there are risks, the risks were acceptable and GM soybean was seen as beneficial and to be encouraged. On the other hand those who perceived modern biotechnology as having higher general concerns, tended to perceive GM soybean as having higher concerns and risks besides low risk acceptance, benefit and encouragement.

With respect to modern technology optimism, there was significantly positive relationship between this factor and general promise of biotechnology, risk acceptance, benefit and encouragement of GM soybean but was negatively correlated with moral aspects of GM

soybean. On the other hand, respondents who ranked higher on post-material values seemed to be able to accept risk more and encouraged GM soybean compared to those who ranked higher on nature value scales. While respondents who have negative predisposition towards science and technology were found to have more general concerns and viewed GM soybean as not familiar, risky and have higher moral concerns but of low benefits, risk acceptance and encouragement. It is interesting to note that those who are more attached to religion and custom tended to see more general benefits of biotechnology but at the same time they were more critical where they also saw more risk aspects of GM soybean.

Structural Equation Modelling (SEM)

In order to understand interrelationships between all constructs which was impossible at the bivariate level, SEM was carried out. Figure 1 shows the final structural model using AMOS version 5.0 with maximum likelihood estimation. The fit indexes indicated a good fit for this model, with χ^2/df ratio of 2.92 and RMSEA value of 0.04 (Kline 1998; Browne & Cudeck 1993)

Interrelationship between attitude dimensions

As can be seen in Figure 1, the six dimensions of attitude towards GM soybean are interrelated. Benefit is strongly correlated to encouragement (β=0.43, $p<0.001$), followed by risk acceptance (β=0.27, $p<0.001$) while moral concern is negatively correlated to encouragement (β=-0.12, $p<0.001$). The findings in this study support some of the earlier studies on public perception towards modern biotechnology. Data from the fourth Eurobarometer survey suggested that perceived benefit was found to be a pre-condition for Europeans support towards seven applications of biotechnology while the moral aspects of modern biotechnology applications appeared to act as a veto (Gaskell et al 2000). Although a biotechnology product or application have clear benefit, but if it is seen as having high moral concerns, the level of support will decrease.

Risk shows a strong negative correlation with benefit (β=-0.43, $p<0.001$) and also has significant negative correlation with risk acceptance (β=-0.26, $p<0.001$) (Figure 1). Earlier researches have suggested an inverse relationship between risk and benefit (Alhakami & Slovic 1994; Gaskell et al. 2000). However if the perceived risk are very severe, no amount of benefit are liable to make the risk acceptable (Hansen et al. 2003; Rowe 2004).

Familiarity is another important dimension in risk perception studies (Rowe 2004). It has significant positive correlation with benefit (β=0.18, $p<0.001$) and risk acceptance (β=0.11, $p<0.001$) (Figure 1). The more familiar the biotechnology product, more benefit is associated with it and the risk will be more acceptable.

Moral concern shows significant correlation with risk (β=0.25, $p<0.001$) but negative correlation with familiarity (β=-0.14, $p<0.001$) (Figure 1). If the biotechnology application has high moral concern, it will also be perceived as having high risk but of low familiarity.

Relationship between general classes of attitude and attitude dimensions

Seven general classes of attitude were correlated with attitude dimensions. General promise of biotechnology is significantly correlated with benefit of GM soybean (β=0.34, $p<0.001$) risk acceptance (β= 0.13, $p<0.001$) and encouragement (β=0.06, $p<0.05$) but is negatively correlated with risk (β=-0.08, $p<0.05$). Pardo et al. (2002) reported a positive correlation between general promise of biotechnology and perceived benefit of biotechnology application and a negative correlation with perceived risk.

General concern of biotechnology is found to be positively correlated with risk of GM soybean (β= 0.23, $p<0.001$) but negatively correlated with risk acceptance (β=-0.07, $p<0.05$). Pardo et al. (2002) also found a positive correlation between general biotechnology concern and perceived risk of biotechnology application.

Technology optimism is significantly correlated with general promise of biotechnology (β=0.21, $p<0.001$) while those respondents who placed material value above nature value tend to perceive more benefit (β=0.10, $p<0.05$). Pardo et al. (2002) reported a positive correlation between technology optimism and biotechnology promise.

Respondents who has negative disposition towards science and technology also tend to perceive GM soybean as having higher general concern (β=0.25, $p<0.001$), higher risk ((β=0.08, $p<0.05$), and higher moral concern (β= 0.10, $p<0.05$) but less perceived benefit (β=-0.08, $p<0.05$). Negative predisposition towards science and technology is also positively correlated with materialistic value (β= 0.12, $p<0.05$).

It is interesting to note that SEM results shows the respondents who are more attached to religion and custom tended to be more critical regarding biotechnology issues (Figure 1). Those who are more attached to religion tended to see more general promise of biotechnology (β=0.17, $p<0.001$), more optimist towards technology (β=0.12, $p<0.001$) but at the same time they also see more risk of GM soybean (β=0.12, $p<0.001$) and

have negative predisposition towards science and technology (β=0.22, $p<0.001$) While those are more attached to custom tended to see higher benefits of GM soybean (β=0.11, $p<0.001$), more optimist towards technology (β=0.16, $p<0.001$) but at the same time also perceived high moral concerns (β=0.10, $p<0.05$) and have a negative predisposition towards science and technology (β=0.13, $p<0.001$). Both attachment to religion and custom are strongly correlated (β=0.46, $p<0.001$).

CONCLUSION

As can be seen from the SEM results in Figure 1 which has been discussed earlier, attitude toward biotechnology application such as GM soybean is a complex issue which involved the interplay between many factors.

This study has confirmed that attitude towards complex issues such as biotechnology should be seen as a multi-faceted/multidimensional process. The most important factors predicting encouragement of GM soybean are the specific application-linked perceptions about the benefits, acceptance of risk and moral concern while risk and familiarity are significant predictors of benefit and risk acceptance.

Attitude towards GM soybean is also predicted by several general classes of attitude such as general promise and concern of biotechnology, technology optimism, nature/materialistic value, predisposition towards science and technology, attachment to religion and custom.

Researchers, policy-makers and industries interested in developing and marketing GM products in Malaysia should consider the various factors mentioned in this study in order to gain public approval.

ACKNOWLEDGEMENT

The authors would like to thank the Food Quality Control Division, Ministry of Health, Malaysia for supporting this research under the 11JC/001/2004 grant.

REFERENCES

Adib A. Rahman. 2004. GM food submitted for market approval. Personal communication. 12 Jun.

Aerni, P. 1999. Public acceptance of genetically engineered food in developing countries: the case of transgenic rice in the Philippines. *Ag. Biotech. Net* 1, November. ABN 031.

Alhakami, M.W. & Slovic, P. 1994. A psychological study of the inverse relationships between perceived risks and perceived benefits. *Risk Analysis* 14: 1085-1096.

BIOTEK. 2002. Biotechnology in Malaysia. http://www.biotek.gov.my. (12.8. 2002)

Brathwaite,V. & Ahmed, E. 2004. A threat to tax morale: the case of Australian higher education policy. *Journal of Economic Psychology* (in press). www.sciencedirect.com (10.2. 2005)

Browne, M.W. & Cudeck, R. 1993. Alternative ways of assessing model fit. In: Bollen, K.A. & Long, J.S. (Eds.). *Testing structural equation models*: 445-455. Newbury Park, CA: Sage.

Einsiedel, E.F. 1997. Biotechnology and the Canadian public. Report on a 1997 National Survey and some international comparisons. Alberta: University of Calgary.

Hansen, J., Holm, L., Frewer, L., Robinson, P., & Sandoe, P. 2003. Beyond the knowledge deficit: recent research into lay and expert attitudes to food risks. *Appetite* 41(2):111-121.

Gaskell, G., Alum, N., Baouer, M., Durant, J., Allansdottir, A., Bonfadelli, H., Boy, D., Cheveigne, D.S., Fjaestad, B., Gutteling, J.M., Hampel, J., Jelsoe, E., Jesuino, J.G., Kohring, M., Kronberger, N., Midden, C., Nielsen, T.H., Przestalski, A., Rusanen, T., Sakellaris, G., Torgersen, H., Twardowski, T., & Wagner, W. 2000. Biotechnology and the European public. *Nature Biotechnology* (18): 935-938.

Gaskell, G., Allum, N. & Stares, S. 2003. Europeans and biotechnology in 2002. Eurobarometer 58.0. 2nd Edition. A Report to the EC Directorate General for Research from the Project 'Life Sciences in European Society' QLG7-CT-1999-00286.

Hair, J.F., Anderson, R.E., Tatham, R.L. & Black, W,C. 1992. *Multivariate data analysis with readings*. New York: MacMillan Publishing Company.

Kamaldeen, S. & Powell, D.A. 2000. Public perceptions of biotechnology. Food Safety Network Technical Report #17, Department of Plant Agriculture, University of Guelph.

Kelley, J. 1995. Public perceptions of genetic engineering: Australia, 1994. Final report to the Department of Industry, Science and Technology, May 1995.

Kline, R.B. 1998. *Principles and practice of satructural equation modelling.* New York: Guilford Press.

Latifah Amin, Jamaluddin Md. Jahi, Abd Rahim Md. Nor, Mohamad Osman & Nor Muhammad Mahadi. 2004. The development of an instrument for public attitude towards modern biotechnology in Malaysia. *Proceedings of 2nd Bangi World Conference on Environmental Management:* 630-635. Bangi: Centre for Graduate Studies, Universiti Kebangsaan Malaysia.

Pardo, R., Midden, C & Miller, J.D. 2002. Attitudes towards biotechnology in the European Union. *Journal of Biotechnology* 98: 9-24.

Rohrmann, B. 1999. Risk perception research: review and documentation. 1999. Research Center Juelich: RC Studies #68. http://www.kfa-juelich.de/mut/hefte/heft_69.pdf (24.7.2003).

Rowe. 2004. How can genetically modified foods be made publicly acceptable?. *Trends in Biotechnology* 22(3): 107-109.

Sagar, A., Demmrich, A. & Ashiya, M. 2000. The tragedy of the commoners: biotechnology and its public. *Nature Biotechnology* 18, January 2000: 2-4.

Sekaran, U. 1992. *Research methods for business: a skill building approach.* New York: John Wiley & Sons.

[1] *Centre for General Studies*
[2] *Centre for Graduate Studies*
[3] *Faculty of Social Sciences & Humanities*
[4] *Faculty of Science and Technology*
Universiti Kebangsaan Malaysia
43600 UKM, Bangi, Selangor D.E., MALAYSIA.

E-mail: nilam@pkrisc.cc.ukm.my