

CHAPTER 1

Overview and rationale of study

1.1 Introduction and rationale

Two important events that have no apparent direct link to each other received considerable attention lately. Firstly, in 2002, the United Nations (UN) declared the period from 2005 to 2014 as the Decade of Education for Sustainable Development (ESD). Secondly, the Human Science and Research Council launched the Human Genome in Africa Initiative (HGAI) in March 2003 to address Africa's crucial needs through genetic technologies. Both these major initiatives hope to address some of the key problem areas, many of which have been described by the World Bank (2002a:1) in the Millennium Development Goals (MDG), particularly in southern Africa.

The Decade of ESD claimed (Tilbury & Goldstein 2003) to be of critical importance in achieving sustainable development (SD) because not enough has been achieved in the decade since the Earth Summit in Rio de Janeiro (1992). The Decade calls for ESD to become a priority matter and countries should address the issues raised by the Commission on Sustainable Development. The second initiative, the HGAI, has provided an impetus to modern gene technology in the century that is claimed to belong to modern biology – specifically gene technology (Fox-Keller 2002:147; Brenner 2003) in Africa. This initiative emphasised the importance of issues like poverty alleviation and health improvements in SD and the MDG.

A flood of gene technology related communications has appeared in the public media since the HGAI. The issue that has received a lot of attention is genetically modified (GM) crops particularly relating to food security and poverty, a key MDG. The GM crops issue has already received immediate attention as indicated by various initiatives. Public Understanding of Biotechnology (PUB) initiative was established to allow transparent communication and education about biotechnology (Joubert 2003:6) with a key emphasis on GM crops and foods. This programme forms part of the National Biotechnology Strategy of South Africa. In addition, the GM crops issue is addressed in the Revised Curriculum Statement for Life Sciences Grades 10 –12 (Department of

Education 2003:35). The GM crops issue forms part of the school curriculum within a politically contentious environment.

The GM crops issue is strongly political, for no less than five international regulations relate to research into, the trade of and use of GM crops (Nuffield Council on Bioethics 2003:65). These are: Agreements by the World Trade Organisation (WTO); the Codex Alimentarius; the Cartagena Protocol on Biosafety under the Convention of Biological Diversity; the International Treaty on Plant Genetic Resources for Food and Agriculture and Directives and Regulations by the European Union (EU). The politics around GM crops resulted from controversy surrounding the issue and the application of the precautionary approach. Agricultural researchers and food producers (Thompson 2002:2) claim that GM crops will certainly assist in achieving food security, but this takes place amidst pressure from activist groups like Greenpeace and Earthwatch, who raise questions about the impact on environment and human health. Groups like these have been far more active in the United States of America (USA) and EU than currently in southern Africa.

The controversy deals with more than promises versus threats (Webster 1999:414). The uncertainty of unknown outcomes and unintended effects of GM crops extend to a political dilemma. Political institutions find themselves unable to keep up with this new technological development (Beck 1991 cited in Webster 1999:414). They become disempowered and have to act as administrators of a development they neither planned nor are able to structure, but somehow have to justify. This embodies a deficit model which attributes the uncertainty and risk to the public misunderstanding of science.

There have been numerous efforts to understand the public's perception with regards to GM crops and foods around the world. Only a few such surveys have been conducted recently in southern Africa by organisations like PUB, Africabio and the National Consumer Forum (NCF) of South Africa. These were primarily done to ascertain public opinion, attitude and knowledge of the GM issues. Some objectives in the PUB Business Plan (Joubert 2003:7,10) express the need for perception (knowledge and opinion) studies of key audiences.

GM crops are a serious issue in SD because they raise environmental, social, economic and political concerns. Therefore environmental educators are compelled to deal with it. Landing education and particularly environmental education with this thorny issue will require intervention. A study of environmental educators' perceptions on the use of GM crops towards SD will be useful to determine the approach and emphasis in educational programmes that address controversial poverty related issues.

1.2 Problem statement and research questions

The study aims to determine the implications of environmental educators' perceptions of the use of GM crops towards sustainable development. Firstly, it is necessary to establish what are the perceptions of environmental educators of the use of GM crops towards SD. To ascertain this, the following question was set: What are the perceptions of environmental educators at the Environmental Educators Association of Southern Africa (EEASA) Conference 2004, of the use of GM crops towards sustainable development?

The researcher is of the opinion that previous surveys are limited by the fact that they focus on knowledge, attitudes and opinions as the key perception indicators. From these surveys, it appears as if the relationship between knowledge, attitudes and opinions is linear, i.e. that attitudes will be more positive and acceptable if more balanced information is supplied (Joubert 2003:5; Kempen, Scholtz & Jerling 2003:17; Cole 2003; Joubert 2001; Webster 2001). To explore other factors relevant to perceptions a more open-ended qualitative study is necessary. A few questions to explore these were posed initially:

- What do environmental educators know about GM crops?
- What is their opinion on the use of GM crops towards sustainable development?
- How do they see GM crops in relation to other biotechnologies?
- Do they see GM crops as a pressing issue in sustainable development?
- How does their perception compare to public perception surveys done by PUB?

These questions were extended and formed the basis of the questions that were asked in the interviews (see Appendix A).

1.3 Aim of the research

The aim of the research was to determine the perceptions of environmental educators of the use of GM crops towards SD. A rich data source is necessary to identify the different (also unexpected) indicators that determine perceptions of environmental educators as well as the link between these indicators. Open-ended semi-structured questions were used in interviews to determine these. Environmental educators' perceptions will give an indication of how to construct educational programmes that will ensure greater participation of the various stakeholders in the debate.

1.4 Theoretical perspective

Understanding the global and historical context of food security and poverty, as a MDG to address SD, particularly in southern Africa is imperative. The main reason advocated for the use of GM crops is to address key needs like food security and poverty relief in southern Africa. This context is completely different from situations in Europe and the USA, where the GM crops issue has been debated fiercely.

The GM crops issue is very controversial and has strong opposing poles. A question that needs to be asked, is whether it is an issue that environmental educators need to take cognisance of? Proponents of GM crops see GM crops as instrumental in poverty alleviation and as a means to increase food security. Addressing problems of poor soil, production of insect resistant crops and crops that are herbicide tolerant (Thompson 2002:2) can increase food production ability of rural farmers who are almost entirely dependent upon the land for their livelihood. Although proponents see GM crops as part of the strategy, it is met with strong opposition from environmental and social justice groups like Biowatch and Safeage who are active in southern Africa. The anti-GM groups claim that GM crops are not able to achieve food security and alleviate poverty, because of the uncertainty that exists surrounding the benefits and the unintended effects that they may have on the environment and human health. Other issues, which raise more general concern, deal with intellectual property rights, monopoly by the gene giants and involvement of civil society in the decisions regarding GM legislation.

GM crops are a global (environmental) concern, in particular in southern Africa, considering the complication of the GM crops debate and the many spheres it affects. Environmental educators will have to become role players in the process. It is necessary to ascertain what their role should be. This can only be determined once it is established how environmental educators perceive the use of GM crops towards sustainable development. Scientists in South Africa claim that knowledge, particularly the lack of scientific knowledge, is the key issue to address with regards to GM crops. Scientific knowledge is necessary, but it is not sufficient because perceptions about risk issues are often socially constructed (Weber, Hair & Fowler 2000:29). Examining more than cognitive indicators that influence perceptions would produce valuable information for greater participatory, reflective and critical environmental education programming.

GM crops are perceived as a contemporary risk issue (Beck 2000: 218). Modern risk issues are different from conventional thinking about risk. Contemporary risks become de-linked from geo-physical boundaries and are intrinsically politics of knowledge and expertise (Goldblatt 1996:158). In view of Beck's theory of modern risks as posed by GM crops and other perception studies, there seem to be several indicators that determine perceptions: knowledge or unawareness (the lack of knowledge); uncertainty; the dominant knowledge system; ethics, culture, values and beliefs; and trust. Are these also the indicators that influence the (risk) perceptions of environmental educators regarding an issue like GM crops?

Drawing from the perceptions of environmental educators, some pointers can be given as to the role they should play in the process, without imposing the task of addressing the issue onto them. ESD clearly asks for greater participation, involving reflective practices and critical thinking (Tilbury & Goldstein 2003). Designing programmes and activities in both formal and non-formal settings to address the GM crops issue would be the challenge.

1.5 Scope of the study and definition of terms

This study is one of a few studies/surveys done on perceptions of GM crops/food in developing countries. Developing countries, according to the Nuffield Council on Bioethics (2004:4), are those countries with gross national product (GNP) in 2001 of less than US\$9,205 per capita. However, other influential factors such as purchasing power

of the country's currency, composition and efficacy of its spending on basic health and education, its income distribution, climatic and other risks are also considered. Circumstances in Africa and particularly southern Africa are very unique and these will be described in paragraph 2.2.3 in more detail. Southern Africa includes the following countries: Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

In most of these countries poverty and food insecurity prevails. Poverty as defined by the World Bank (2002a:3) includes utility and capacity concepts, therefore it is a multidimensional concept. Lack of sustainable livelihood, good health, being vulnerable to environmental changes, and not being in control of decisions related to the environment, all contribute to extreme income poverty and malnutrition. Food insecurity is expressed by the Food and Agricultural Organisation (FAO) cited in Task Force on Science and Technology in Securing Food in the 21st Century (2002:1) as the 400 million persons without diversity, quality (all the basic nutrients) and quantity of food for healthy living. Factors like population growth, increasing urbanisation, globalisation of markets and technologies all affect a country's food production ability. Contrary to the rest of the world, the number of food insecure persons in southern Africa has increased according to the Task Force on Science and Technology in Securing Food in the 21st Century (2002:4). Poverty and hunger are key issues and expressed in the MDG to be addressed in order to achieve SD.

Sustainable Development is a concept that is laden with ambiguity, but the generally agreed definition made in the *Brundtland Report* (1987) states that it is a kind of development that aims to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. Fien and Tilbury (2002: 5) highlight that SD has to promote a greater consideration for social justice in an ecologically sustainable way when dealing with environmental problems and issues. Addressing food security and poverty puts pressure on societies, and will require innovative approaches such as biotechnology.

Thompson (2002:9) defines biotechnology as the exploitation of biological processes to produce commercially valuable products and processes. It includes a wide range of

processes and techniques like bread, wine and cheese making but also modern advances of gene technology like genetic modification. Genetic modification allows for selected individual genes to be transferred from one organism to another, including genes from unrelated species. This technology can be used to promote a desired crop character or to suppress an undesirable trait (Nuffield Council on Bioethics 2004:3). GM foods and feeds are the products of GM crops which are processed for human or animal consumption.

Anti-GM groups advocate that GM crops pose great risks. According to Beck (2000:213), risk as perceived by the public, is when there is no longer trust/security but not yet destruction/disaster. The concept of contemporary risks differs from the conventional view of risk. Weber et al (2000:29) elicited that an individual's perceptions regarding environmental problems are socially constructed, especially when the risk is not experienced first hand. Perceptions are partially derived from information presented in the mass media and environmental curricula rather than from immediate sensory contact with the issue. Cothorn (1996:43) highlights a few other aspects of perceptions regarding environmental risk. Emotional feelings, educational background, steeped biases like cultural, social or gender stereotypes and confused language can all provide a block to the communication of facts and influence the perception of the risk issue.

The perceptions of possible risks, as posed by GM crops and other new technologies, invoked the precautionary approach. Principle 15 of the *Rio Declaration on Environment and Development* (1992) stated: '*In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*' This principle is at the center of the current debate of risk management (Conko 2003:2). Interpretations of the precautionary principle may be stumbling block to environmental educators dealing with GM crops issues.

Environmental educators in southern African call for the promotion of interdisciplinary and multidisciplinary studies of the environment and the dissemination of information regarding environmental education, as expressed in some of the aims of the *EEASA Constitution* (EEASA 2001:1). This makes an issue like GM crops which has potential

environmental, social, political and economical impact in the region extremely relevant for environmental educational processes addressing sustainability issues. Determining the perceptions of environmental educators regarding the use of GM crops should provide a valuable starting point to the role they will play in these processes.

1.6 Overview of research design and methods

A qualitative study allows us to understand social factors and the meaning that people attach to them (Poggenpoel, Myburgh & Van der Linde 1999:409). For this study structured open-ended interviews were used to generate the data regarding environmental educators' perceptions of the use of GM crops. These interviews were conducted at the EEASA Annual Conference during April 2004. The interviews were transcribed and the data phenomenologically analysed. The implications of interviewees' perceptions of this issue are drawn from the data through interpretation of the results.

1.7 Chapter divisions

Chapter 2 is a review of literature. The context in southern Africa is sketched, and the controversy and the importance of perceptions of GM crops in implementation of sustainable development initiatives are explained. This is related to environmental educators who have to deal with education for sustainable development.

Chapter 3 explains the research design used to determine environmental educators' perceptions of the use of GM crops towards sustainable development. It explains how the data was obtained and analysed.

Chapter 4 sets out the results as obtained from the structured open-ended interviews. The results show the relevant connections between environmental educators, sustainable development and GM crops. Several general and unique themes are identified.

The results are discussed in Chapter 5 by comparing the findings with that which is explained in the literature review in Chapter 2. It also identifies the limitations of the study as well as unexpected findings. Conclusions are drawn, the research questions answered and recommendations made for further study.

CHAPTER 2

GM crops as means to sustainable development - controversy and perceptions

2.1 Overview

The impact of human activities and influences on the environment have escalated over the last half of the previous century, and so have the risks and threats associated with those activities (Palmer 1998:35). The need for whole-scale education relating to our responsibilities towards the environment (Palmer 1998:5) is acute. Within the global challenge the vulnerability of the poor in southern Africa is a particular priority for the international community. This chapter will look briefly at a past technological approach (the Green Revolution) and a modern technological approach – GM crops. The particular emphasis will be on how GM crops can contribute to a more sustainable future in terms of food security for southern Africa. However, GM crops issues are very controversial and the process has produced a myriad complexities: possible risks and threats, ethical issues and other social issues.

Societal perceptions of risk (or benefit) about the issue of GM crops has resulted from uncertainties, lack of knowledge, different knowledge systems, mistrust and ethical considerations. All these contributed to the dilemma for environmental educators of how to approach this issue. They themselves, as part of society, are equally likely to hold their own biased perceptions of GM crops which in turn will influence the way they address this issue. Therefore it is important to determine the perceptions of environmental educators of the use of GM crops.

2.2 The context

Environmental education requires a critical approach to environmental issues. According to Fien (1995:55), the development of a critical environmental consciousness is based upon the following:

- A holistic view of the environment in totality as an interdependent relationship among natural and social systems (Biophysical, social, economical and political)
- A historical perspective of current and future environmental issues

- A study of cause and effect of environmental problems, thus examining the relationship between ideology, economy and technology

This section will briefly examine the objectives of sustainable development and provide a holistic view of poverty and food insecurity. Examining the GM crop debate in the context of poverty and food insecurity is paramount to addressing this issue in southern Africa. The indicators that determine the perceptions of the use of GM crops are rooted in this context.

2.2.1 The Global Challenge – sustainable development

Agenda 21 emerged from the 1992 Earth Summit in Rio as the principle agreement to integrate environmental and development issues. *Agenda 21* was designed to fulfil basic needs, improve living standards for all and better manage and protect ecosystems for long term sustainability (World Bank 2002a:1). These and many more agreements commit governments, with the support of other social actors, to take responsibility to change and move society towards sustainable development (Tilbury & Goldstein 2003). Several international ‘think tanks’ took place to develop the concept into practical implementation plans. In 2001 at the World Summit on Sustainable Development (WSSD), a Plan of Implementation was proposed to achieve the United Nations (UN) Millennium Development Goals by 2014. The Millennium Development Goals (MDG) focus the effort of the world community on achieving significant and measurable improvements in people’s lives. These goals have been commonly accepted as a framework for measuring development progress. The World Bank (2002a:2) states these goals as follows:

- Eradicate extreme poverty and hunger
- Achieve universal primary education
- Promote gender equality and empower women
- Reduce child mortality
- Improve maternal health
- Combat HIV/AIDS, malaria and other diseases
- Ensure environmental sustainability
- Develop global partnerships for development

Today social-scientists, economists and environmentalists hold discussions about sustainable development around these specific issues. Education is seen as the most effective means that society possesses for confronting these future challenges (UNESCO 1998:15) and to achieve these goals (Palmer 1998:35; Hopkins & McKeown 2002:13). These global needs (as expressed in the MDG) are more clearly articulated today, but it is not the first time that the world has attempted to address some of these crucial needs. The Green Revolution was such a previous attempt.

2.2.2 History of the Green Revolution

In the 1950's and 1960's it was feared that the developing countries, particularly China, India and Indonesia, would be unable to feed their rapidly growing populations (World Bank 2003:1). Scenarios of famine and starvation did not materialise in these countries, due to the Green Revolution in agriculture.

The Green Revolution is the popular term used to describe the development and spread of high-yielding staple foods in developing countries. It began with maize hybrids in the 1950's. The main component was the introduction of semi-dwarf wheat and rice varieties, mainly in parts of Asia and Central America with well-functioning systems of irrigation, between 1962 and 1985. It also involved the increased use of fertilisers, pesticides and mechanical agriculture (Lipton & Longhurst 1989, cited in De Vries & Toenniessen 2001:25). The increases in agricultural productivity in most regions of the world resulted in lower food prices, making food more accessible to the poor, contributing to increased life expectancy and providing a platform for broader, economic development (De Vries & Toenniessen 2001:25). Between 1970 and 1990 it brought about great improvement in crop yields, resulting in the dramatic reduction of poverty and hunger (Nuffield Council on Bioethics 2004: xiii).

However, continuous cropping during the Green Revolution led to the build-up of pests and diseases (Khush 1990 cited in De Vries & Toenniessen 2001:35). People farming poorer lands were more reluctant to make investments (Lipton & Longhurst 1989 cited in De Vries & Toenniessen 2001:35) in fertilisers and water supply and faced a greater risk of crop failure. Farmers, particularly in southern Africa, are most affected when fertilisers and water supply are in short supply (Thompson 2002:155). As a result cereal yields have changed little over the past 40 years and production per capita has steadily

declined. Therefore, the Green Revolution was not met with success in Africa (Thompson 2002:155). The improvements of the Green Revolution were not sustained and other problems arose like water shortages, soil degradation and the emergence of new types of pests and disease (Nuffield Council on Bioethics 2004:13).

The result is that society in southern Africa treats new developments with scepticism. This has implications for the development of programmes that wish to address poverty and food security, since scepticism is a barrier to new technological developments. In addition, the situation in southern Africa is particularly challenging from an environmental and social perspective.

2.2.3 The challenging environmental and social context in southern Africa

Southern Africa is home to 291 million people of whom 75% live in rural areas and are largely dependent upon natural resources for their livelihoods (Lotz-Sisitka 2004:5). Natural resources are key biophysical life-support systems to these people and access to them is threatened by increasing population levels.

There is a complex array of factors that contribute to low levels of food production in southern Africa as described by De Vries and Toenniessen (2001:10, 22):

- Production constraints - The majority of people live on farms that cover an area of less than 5 ha and are hand-tilled. Crops are grown with minimal purchased inputs.
- Diverse cropping landscape – The area cultivated in Africa is of immense size and has great environmental variations, from the slopes of Mount Mulangi to the fringes of the Sahara. Cropping patterns and dietary staples vary widely from one end of the continent to another. Issues such as temperature, natural drainage, rainfall patterns, soil fertility, pest and disease occurrence determine to a large extent which crop can be used where.
- Seed market failure - Multinational seed companies found it less profitable to devote significant resources to developing varieties with specific adaptive advantages as required by small-scale, low input farmers. The profit share increase is small compared to profits available in the developed world (Tipps 2000 cited by DeVries & Toenniessen 2001:22). Furthermore, the low rates of

economic growth in much of Africa are less likely to attract large-scale investment from outside the continent.

- Policies and institutional critics – Few African countries have prioritised food security through development of the agricultural sector and have received little encouragement to develop this sector from Western governments.
- Soil fertility – Intensive cultivation does not replenish nutrients of the soils. Moreover, the soils in southern Africa are seen as of the poorest worldwide. Debra (2000 cited in De Vries & Toenniessen 2001:24) stated that the net nutrient outflow per year in Africa is estimated at 63 kg/ha/year on average. Using low-cost methods such as legume rotation and green manures still limits soil fertility and hence production. Domestic inorganic fertiliser prices in Africa are at least five times higher than world prices (DeVries & Toenniessen 2001:25), thus increasing input costs and becoming a real barrier to sustainable crop production.
- Globalisation - The last few decades of the 20th century were characterised by the fastest growth of the global economy ever recorded over a similar period of time. Scientific innovations and technologies together with opening up of economies throughout the world have permitted people to improve the quality of their lives (De Vries & Toenniessen 2001:3). Globalisation is referred to as capital mobility and global distribution of technology, which brings opportunity to innumerable groups of people. At the close of the previous century it became apparent that not all of the world's population benefitted equally by this trend. A significant proportion of the world failed to benefit from globalisation. The increasing domination and control of international and local markets by large, mostly Western-based corporations (World Bank 2002a:45) resulted in the developing world, particularly Africa, being left behind.

Environmental educators from southern Africa will agree that this challenging situation requires new and innovative approaches to problem solving. The factors discussed in this paragraph form the basis of many social and ethical issues surrounding GM crops in southern Africa. Moreover, they are the main environmental issues that have contributed to the problem of food insecurity and poverty, as described in the MDG.

2.2.4 Food insecurity and poverty

The Food and Agricultural Organisation (FAO) defines food security as a state of affairs in which all people at all times have access to safe and nutritious food to maintain a healthy and active life (Hohn & Leisinger 1999: 2). Food security requires that the food supply meets the total demand for food. Although the supply is meeting the demand, this is not sufficient. Globally, adequate food is produced, yet 800 million people in developing countries have inadequate access to food (Hohn & Leisinger 1999:3) because they are too poor to buy it.

Various interlinked adverse conditions and socio-economic systems in southern Africa that are contributing to food shortfalls have been explained in paragraph 2.2.3. These and other factors such as poor access to and poor quality of education, limited livelihood options, the spread of HIV/AIDS and various threats to peace and security (Lotz-Sisitka 2004: 5) contribute to the international concern - poverty.

Eradication of poverty is one of the key targets of MDG. Extreme poverty and hunger are closely related to the ability to make a living and the vulnerability of households to risks, such as illness and natural disasters. The latest definition of poverty according to the World Bank (2002a:21) is that the definition should include utility and capacity concepts, therefore it is a multidimensional concept. Lack of sustainable livelihood, poor health, vulnerability to environmental changes, and lack of being in control over decisions related to the environment, contribute to extreme income poverty and malnutrition.

Although there is broad consensus that there is sufficient food available in the world to meet the dietary energy requirements of all people, the lack of access to food continues to contribute to food insecurity (Task Force on Science & Technology in Securing Food in the 21st Century 2002:1). Increasing global populations, degradation and depletion of natural resources, the impact of climatic change, and the levelling out of enhanced crop yields achieved during the Green Revolution add to the challenge of food security. In addition, a shortfall of 88,7 million tons of grain by the year 2025, as predicted (Thompson 2002:154) poses a far greater challenge for southern Africa. There is thus a search for new technologies in order to increase the diversity, quality and quantity of food produced in developing nations, particularly southern Africa where the number of food-insecure persons is increasing in contrast to the rest of the world (Task Force on

Science & Technology in Securing Food in the 21st Century 2002:viii). This makes people in southern African particularly vulnerable and prone to risks.

International and regional frameworks like MDG and New Partnership for African Development (NEPAD) clearly aim to address fundamental problems like poverty and food insecurity with the intention to minimise perceived threats to the future (Lotz-Sisitka 2004:36). Dominated by the political economy of the time, these frameworks tend to obscure many of the complex and underlying causes of the socio-ecological issues that humanity is trying to address. That is why there is much speculation by writers like Beck (1992 & 1999 cited in Lotz-Sisitka 2004:36) about the rationality driving these global (and regional) frameworks. Beck raises the question about the value of placing too much faith in these 'rationalist-planning frameworks' for the future.

The Task Force on Science and Technology in Securing Food in the 21st Century (2002:viii) is of the opinion that modern biotechnologies (like GM crops) applied along with other agricultural practices such as integrated pest management, water resource management, and biodiversity conservation can achieve a multi-disciplinary approach to mitigate food insecurity and therefore reduce the risk to poor people. However, biotechnologies (like GM crops) are integral to rationalist-planning frameworks (like MDG and NEPAD) and do not only promise many benefits, but also pose risks to poor people.

Sustainable development urges that food insecurity and poverty be addressed. Southern Africa is already traumatised by the failure of the Green Revolution and challenging environmental and social conditions. Food insecurity is only one of multidimensional factors that contribute to poverty. Addressing food insecurity and poverty through rationalist-planning frameworks can pose greater risks than benefits to poor people. The poor need to be empowered by the application of new technologies like biotechnology. Empowering the poor means expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control and hold accountable institutions that affect their lives (World Bank 2002b: xviii). This could become part of environmental educational processes.

2.3 Addressing food insecurity through modern technology

The use of modern biotechnology, specifically GM crops, to address poverty and food insecurity to ensure sustainable development is provoking heated debates. The Green Revolution, a technological approach that did not yield satisfying results in much of Africa, is still fresh in the minds of people. A parallel is made with environmental education. Firth and Plant (1996: 197) stress that environmental education, in the early years, was dominated by a technocentric (Western) approach which was aimed at enhancing environmental management and control by seeking scientific and technological solutions to urgent environmental problems. Matters of environmental quality and human development (Fien & Tilbury 2002:9) have to be central in ESD.

This section will look at GM crops as part of biotechnology, the controversial aspects of the GM crop debate and some of the complexities surrounding the issue. Environmental educators need to take cognisance of this technological approach (GM crops) that raises many social and ethical questions. Environmental educators must have a clear understanding of GM crops and the GM crops debate to make more meaningful contributions to related educational processes.

2.3.1 GM Crops as part of biotechnology

Biological processes using micro-organisms (like bacteria and yeast) have been used for centuries to make useful products like bread, wine, yoghurt and cheese. Humans have grown crops and raised animals for thousands of years (Cloete 2003:6; AfricaBio 2002:4). Biotechnology is a general term and used in its broadest sense, refers to a variety of techniques involving living organisms as a means of production (Avramovic 1996:7). The techniques of biotechnology have evolved and can be characterised by three major phases or generations:

1st Generation

This dates back to the Stone Age and uses of biological organisms such as bacteria and yeast, enzymes and traditional methods to produce food and drink such as bread and wine.

2nd Generation

The second generation was initiated by the discovery of penicillin in 1928. This led to large-scale fermentation production of products for the pharmaceutical industry, and the

expansion of research efforts leading to new antibiotics and an increasing range of enzymes, vitamins and steroids. A critical development, such as the use of hybrid crop varieties resulted in dramatic increase in yields in the US Corn Belt in 1930's. This has led to a significant increased interest in micro-organisms, the successful use of mutations and selective breeding to improve yields and efficiencies, and refinement of fermentation technology, notably methods to immobilise enzymes.

3^d Generation

The third generation is referred to as modern biotechnology. The discovery of deoxy-ribo nucleic acid (DNA) in 1953 by Watson and Crick of Cambridge University opened up a whole new dimension of a set of enabling techniques with the potential to increase efficiency of industrial processes. The wealth of information about the way DNA functions and is organised in cells, enabled the creation of new products and processes ranging from paper and wood products to textiles, rubber, pharmaceuticals and agricultural products (Avramovic 1996:12).

Modern biotechnology is used to solve problems or make products. These include products such as:

- Drugs and vaccines
- Medicines to treat diseases like various cancers, Alzheimer's disease, heart disease, diabetes, multiple sclerosis, AIDS and arthritis
- Medical diagnostic tests
- Biotech food like papaya, soya beans and maize
- Bio-pesticides and agricultural products

It can be employed to solve problems in fields such as:

- Environmental biotechnology – to clean up hazardous waste
- Industrial biotechnology - cleaner processes that produce less waste, and uses less energy and water e.g. laundry detergents containing enzymes
- DNA fingerprinting in criminal investigations and forensic medicine
- Anthropology and wildlife management

Biotechnology is one of the most research-intensive industries in the world (Cloete 2003:6). Studies like proteomics have arisen since the completion of the Human Genome Project. The latter involves deciphering the network of proteins within cells and

tissues. Biotechnology is, as Cloete (2003:7) puts it, a field for unsurpassed discovery and intellectual adventure, described as the 'biotech gold rush'.

Agricultural research and technology, specifically biotechnology, can play an instrumental role in addressing the challenge of food insecurity. As part of a comprehensive socio-economic framework, biotechnology is aimed at reducing poverty, increasing incomes and facilitating access to health and education for rural poor (Task Force on Science & Technology in Securing Food in the 21st Century 2002:12). This contributes to sustainable development.

Biotechnology, specifically GM crops, claims to have many useful applications but also raises questions about the environment and food safety. Political, social and ethical questions are raised about issues in biotechnology particularly human cloning and GM crops. These have been sensationalised by the mass media (Cloete 2003:6). This study will focus on the issues surrounding GM crops.

In order to determine whether genetic modification of crops presents a solution, which can contribute to a more sustainable world, or whether it is a threat to quality of life, one must clearly understand what GM crops entails. Consideration of the controversial aspects of the debate and the complexities of the GM crops issue will help to answer the following questions:

- What benefits do GM crops offer to promote sustainable development?
- What threats do GM crops pose to sustainable development?
- What are the issues that relate to the use of GM crops in sustainable development?

A key point of confusion often raised in the GM crops debate is the relation of GM crops to biotechnology in general. GM crops form part of modern biotechnology. However, GM crops are one of the complex and controversial aspects in biotechnology. Unravelling some of the controversial aspects and complexities of the GM crops debate will allow insight in the perceptions of GM crops.

2.3.2 Benefits of GM crops

GM crops are perceived as strongly beneficial by pro-GM groups. The age-old problems of crop loss, low productivity and nutritional deficiency are still evident in the rural areas where 75% of the world's poor, who are almost entirely dependent upon agriculture for their livelihood, live. Proponents of genetic modification such as Conko and Prakash (2003:25) believe that GM crops can offer tremendous benefits for the environment, farmers and the consumers if given the chance to prove itself.

The Nuffield Council on Bioethics (2004:26) summarised the benefits of genetically modified crops under the following headings:

Herbicide tolerance. This involves transgenic plants (plants that have been genetically modified to have a desirable crop character promoted or an undesirable trait suppressed) that are tolerant to specific herbicides allowing farmers to apply herbicide that acts on a wide variety of weeds without affecting the modified crop plant. Herbicide tolerance is the most commonly used GM trait world-wide and is applied to crops like soybean, maize, cotton and oil seed rape. The primary aim is to reduce the applications of herbicides.

Insect/pest resistance. The genetically modified plant will produce toxins to specific insects that feed on the crop. This application is already leading to substantial reductions in the use of pesticides and insecticides. Examples include insect-resistant cotton, maize and potato varieties.

Bacterial, fungal and viral resistance. Transgenic plants are resistant to biotic stresses such as plant pathogens, which are often the cause of substantial reduction in yield. Examples include coffee, banana, cassava, potato, sweet potato, beans, wheat, papaya, squash and melon.

Abiotic stress resistance. Some plants have the ability to survive in harsh climatic conditions. This ability is sometimes associated with specific groups of genes that can be isolated and introduced into crops. It promises to be valuable to developing countries where abiotic stresses such as drought, heat, frost and acidic or salty soils are common. Examples are cotton, coffee, rice, wheat, potato, *Brassica*, tomato and barley varieties.

Micronutrient enrichment. This characteristic aims to prevent malnutrition and play a vital role in provision of vitamins and minerals through enriching staple crops, for example research currently undertaken in rice, cassava, millet and potato.

Biopharmaceuticals is an application of genetic modification that introduces vaccines in crops. Practical application is distant, but it offers inexpensive and far-reaching provision of vaccines against diseases such as severe diarrhoea and hepatitis (Nuffield Council on Bioethics 2004:43).

By no means do the proponents of GM crops like Conko and Prakash (2003:25) see this as the only answer to the problems of the developing world, but as part of the overall solution. There is a growing awareness that research and development in the field of biotechnology can contribute more to the developing world where markets are less profitable.

2.3.3 Possible risks – threats to the environment and human health

Anti-GM activists (Egziabher & Shiva 1998; Altieri & Rosset 1999) seem to agree with The Nuffield Council on Bioethics (2004) about the main possible risks of genetically modified crops.

Gene flow to other plants and organisms. This refers to horizontal transfer which seems particularly the case where GM crops are planted in areas near wild relatives (natural occurring types of plants from which present crops have been created through plant breeding techniques such as wide-crossing).

Possible effect of GM crops on insects and other animals that feed on them. This especially applies where modified crops contain substances which wild relatives of the respective crop would not contain.

Unanswered ecological questions. This refers to the indirect effects GM crops may have on plants, soil and non-target organisms (Altieri & Rosset 1999:4). This is often referred to as the unintended effects.

Questions of food safety. GM of plants can produce new proteins which can act as allergens or toxins. Eating foods that contain these new proteins raises questions of food safety (Altieri & Rosset 1999:2; Nuffield Council on Bioethics 2004: 60). Other possible effects like the transfer of genes to the gut flora, the role of new food in the diet, as well as the influence of processing of food derived from GM crops on human health cannot be predicted. The main risk issues that are raised by activist groups regarding GM crops are mostly about environmental impact and safety for human consumption. These possible risks contribute to uncertainty concerning GM crops and as a result a complex social, ethical and political dilemma emerges.

2.3.4 Social, ethical and political complexity of GM crops

Besides the advantages and disadvantages, there is a Pandora's box of social issues that arise from this new and rapidly progressing technology. Several questions on which there is general consensus arise:

Is it a priority to pursue? This pertains particularly to developments such as Golden Rice (a variety of rice with genes that develop β -carotene in the strain, and aims to help prevent vitamin A deficiency) or the production of biopharmaceuticals. The Nuffield Council on Bioethics (2004:44) asks if investments in these crops would distract attention and resources from other approaches.

Intellectual Property Rights (IPR). IPR for technologies in developing GM crops are held by agrochemical companies. Is this a way to exercise control over the availability of GM crops to developing countries? The increased tendency to license patented GM technologies limit their availability to public sector researchers. Universities and research institutions become handmaidens to the gene giants due to declined allocation of public funds for research.

Multiple factors. There are many factors that influence the actual use of GM crops, like the incidence of pests; impact of pest control on other pests that might require additional applications of pesticides, resistance of pests to toxins and the size of any technology fee.

GM crops may have other social implications such as the reduction of labour and hence job losses. Conko and Prakash (2003:25) claim that the biggest threat to hungry populations is restrictive policies stemming from unwarranted public fears.

In addition, opponents to GM crops/foods make the following statements:

Gene giants exercise monopoly control. For example Monsanto's Round-up ready crops are genetically engineered to their own broad spectrum herbicide (Pschorn-Strauss & Wynberg 2002:7).

GM crops cannot solve hunger. GM technology in rural Africa is seen to repeat the mistakes of the Green Revolution: the use of unpopular technologies which are ineffective and inappropriate to local conditions and not suitable to the complex ecology of African soils, particularly sub-Saharan Africa and lack of access to markets and infrastructure.

A greater amount of involvement of civil society in decision making for approving field trials and commercial releases of GM crops are lacking (Pschorn-Strauss & Wynberg 2002:13).

Much of the dualism about GM crops stem from the implementation of a regulatory framework such as the precautionary approach under the Cartagena Protocol on Biosafety.

The Cartagena Protocol on Biosafety encourages governments to take a precautionary approach to the domestic regulation of transgenic organisms (Conko 2003:1). The precautionary approach is open to a variety of interpretations and much disagreement exists over whether the precautionary approach is a useful tool for managing the risks of technologies and products like GM crops. Conko (2003:8) argued that the precautionary approach has been used to legitimize a bias against change. The Nuffield Council on Bioethics (2004:69) state that a highly restrictive interpretation of the precautionary approach is likely to ignore the possibility that, in some cases, the use of a GM crop variety may pose fewer risks than are implied by current practices or by plausible non-GM alternatives.

Decisions regarding the development, planting and regulation of GM crops take place at many levels. The Nuffield Council on Bioethics (2004:65) suggests that policies towards GM crops must make sense in the context of a country's own development needs, and cohere with the complex system of international governance. Those who seek to be influential in making policy must weigh carefully all the current and relevant evidence and the impact that over-simplified public statements may have in a highly charged political atmosphere (Nuffield Council on Bioethics 2004:80).

These social, ethical and political issues are very complex. Concerning these issues, the answer may be clear to scientists, but the public is often uncertain or indifferent which leaves the decision makers confused. A more holistic and interdisciplinary approach is required to address these issues, rather than through simplified rationalist structures and frameworks that focus primarily on raising awareness.

2.3.5 GM crops a global issue

From the above discussions about the benefits, risks and issues surrounding GM crops, one can conclude that GM crops is a global issue. A global issue is defined by Trisler (1993:1) as the action of an individual or a society that has an impact on other societies. The impact of GM crops has far reaching affects on society. These will be summarised below.

GM crops or more broadly, genetic technology will play a fundamental role in future. The amount of money that the gene giants (companies like Monsanto, Pioneer Hi-Bred, AgrEva, Delta and Pine Land, Sengenta and DuPont who control the seed, pesticide and pharmaceutical markets) and even governments pump into this development is in itself reason to take notice of this issue. For example Nigeria has committed \$26 million per annum to developing biotechnology (Africabio 2002:5). South Africa has formalised a National Biotechnology Strategy (Pschorn-Strauss & Wynberg 2002: 14) and the amount of hectares of GM crops being planted is growing rapidly. Almost 53 million hectares of GM crops are grown worldwide and over 350 000 hectares in South Africa (Pschorn-Strauss & Wynberg 2002: 1).

Priest (2003) pointed out the dualism and confusion that exist within civil societies with regards to GM crops as described in paragraphs 2.3.2, 2.3.3 and 2.3.4. On the one hand it is an expensive technology that seems unlikely to provide a panacea for the world's food distribution problems. GM crops were developed to meet the needs of the First World agribusiness, not small Third World farms. On the other hand, it does not seem wise to ban this technology because of environmental and health risks that seem vague, remote and poorly understood on a continent with serious challenges in bringing sufficient food to its people. Global issues, like GM crops, have led to a world in which foundational risk logic is undermined and invalidated, according to Beck (2000:218). As a result the different agencies and actors contradict each other.

GM crops are a very complex issue with an array of social, economic and political implications. The uncertainty, ignorance and mistrust about GM crops have made it such fuzzy issue so that a passive attitude towards it seems the most appropriate. The result is that the public is sceptical about the benefits of GM crops and GM crops have been largely framed as a risk issue (Gaskell et al 2004:186) in the developed world. Beck

(2000:222) claims that the GM crop issue is a typical risk of modern society. Weber et al (2000:28) said that assessment of perceived environmental risk is important to environmental education because it provides a general overview of the present state of perception regarding the environmental issue. Such an analysis of a contemporary risk issue like GM crops, and the indicators that contribute towards perceptions thereof, will be invaluable to environmental educators dealing with it.

Modern risks stem inevitably and unavoidably from the very heart of the wealth-creating process and thus the problem of chronic over production (Goldblatt 1996:160). Most of southern Africa is poverty-stricken and very different from the developed world. The question can be raised if the same indicators of modern risks in the developed world affect environmental educators' perceptions regarding GM crops in southern Africa. The next section will explore some of the risk perception indicators, as described in literature regarding GM crops.

2.4 Public perceptions of contemporary risks

Risks confronting modern societies are distinctively new and problematic. The production and implications of contemporary risks differ from earlier forms of risk and hazards according to Goldblatt (1996:158). In Goldblatt's analysis of Beck's *Risk Society* (1982, 1999), modern risk is purported to have the following characteristics:

- Contemporary risks are not spatially limited in the range of their impact or socially confined to particular communities. Beck (1992, 1999 cited in Lotz-Sisitka 2004:37) notes that all are vulnerable to the risk of industrialisation, as multinationals and others move freely around the globe and associated risk becomes de-linked from geo-physical boundaries.
- Politics of risk is intrinsically politics of knowledge, expertise and counter-expertise. This means that risks are socially invisible and must clearly be brought to consciousness, only then can it be said that they constitute an actual threat.

To gain insight into contemporary risk would require an analysis of the indicators that determine risk perceptions, in this case risk perceptions about GM crops. The indicators contributing to the risk perceptions of GM crops amongst the public can provide a useful standard with which to compare environmental educators' perceptions. This information can be used in environmental educational processes regarding the use of GM crops.

2.4.1 Perceptions of GM crops

Weber et al (2000:29) argue that an individual's perceptions regarding environmental problems are not experienced first hand. Such perceptions are partially derived from information presented in the mass media and environmental curricula rather than from immediate sensory contact with the issue, i.e knowledge and the knowledge source. Hence, these perceptions are described as socially constructed. Cothorn (1996:43) highlights a few other aspects of perceptions regarding environmental risk. Emotional feelings such as fear, guilt, lack of educational background (e.g. uncertainty), steeped biases like cultural, social or gender biases and confused language (we hear what we want to hear and words are given different connotations) can all provide a block to the communication of facts. These and several other perception indicators have shown to be relevant to the perceptions of GM crops.

Table 2.1 shows a summary of the different indicators that influence perceptions of GM crops, GM foods or environmental risk in general from various studies reviewed. Most of the studies were conducted to determine public perception. Some studies relate to biotechnology or genetic engineering in general rather than GM crops or GM foods specifically. The studies that are included in table 2.1 were conducted in Europe, Japan, Australia, Costa Rica, Argentina and Asia. A few perception studies that include GM crops or foods were conducted in southern Africa. These are discussed in paragraph 5.4.5. The perception studies conducted in southern Africa were done in urban areas where people are less directly dependent upon agriculture for their livelihood. The second column of table 2.1 shows how the perception indicators from this literature survey relate to this study in the interview questions.

Table 2.1 - *The indicators of perceptions in relation to GM crops/food or environmental risks in general.*

Perception Indicator	How Perception indicator relates to this study	Reference
1. Knowledge	Depth of knowledge, bias (in terms of argument) and type of knowledge were determined by interview questions 3 and 5.	Murch (1976:277); Weber et al (2000:29); AFIC and ISAAA (2001:9); Sittenfeld & Espinoza (2002:469); Kelley (1994); Morris & Adley 2001:47)
2. Information and information sources	Interview question 4 gave some indication of the dominant source of information	Weber et al (2000:29); Sittenfeld & Espinoza (2002:469); Morris & Adley 2001:47); Chen Ng et al (2000:112)
3. Emotions (affective)	Interview question 6 refers to "how people feel about GM crops" although it was not directly asked in interviews.	Cothorn (1996:43); Gaskell et al (2004:186)
4. Biographical data	Questions 1 and 2 gathered some basic biographical information. In order to make reliable deductions with regards to age, gender one would need a much larger sample and a quantitative method of analysis.	Mucci, Hough and Ziliani (2004:4); Kelley (1994); Chen Ng et al (2000:107)
5. Values, culture, belief (Ethical considerations)	All these indicators act as preferential filters and influence each other. It was not separately determined in interviews, but Question 6 and Question 5 1 st sub question refer to these aspects.	Murch (1976:279); Cothorn (1996:43); AFIC & ISAAA (2001:9); Kelley (1994); Gaskell et al (2004:186)
6. Language	Often the language used is closely associated to an epistemological view.	Cothorn (1996:43); AFIC & ISAAA (2001:9)
7. Benefit-risk analysis	The sub questions from Question 5 gathered information on risk or benefit perception. These are often a matter of preference, for example people do not prefer GM food because there is no direct benefit associated (a matter of preference).	AFIC & ISAAA (2001:9); Sittenfeld & Espinoza (2002:469); Mucci, Hough et al (2004:4); Kelley (1994); Gaskell et al (2004:186); Chen Ng et al (2000:109)
8. Trust.	Interview question 6 relates to trust in terms of authorities.	Mucci et al (2004:4); Gaskell et al (2004:186); Chen Ng et al (2000:110)
9. Scientific world-view (Knowledge System)	Scientific world-view is dominated by scientific knowledge as oppose to socially constructed knowledge. This was determined as a core threat rather than through specific questions.	Kelley (1994); Gaskell et al (2004:186); Chen Ng et al (2000: 107)
10. Uncertainty	Not directly referred to in interview but would be able to deduce from data generated.	Cothorn (1996:43); Gaskell et al (2004:186)
11. Attitude	Not directly referred to in interview.	Morris & Adley (2001:47); Chen Ng et al (2000:108)
12. Preferences based on needs and interests	Interviewees were selected on the basis that they showed an interest in the subject.	Murch (1976:277); Cothorn (1996:43); Gaskell et al (2004:186)

AFIC - Asia Food Information Centre

ISAAA - (AFIC) and International Services for Acquisition of Agri-biotech Applications

2.4.2 Some indicators of the perceptions of GM crops

Table 2.1 shows a summary of the perception indicators that were revealed in other studies. Some of these perception indicators and their possible link to the perceptions of environmental educators regarding the use of GM crops towards sustainable development in southern Africa are discussed in the ensuing paragraphs.

As a modern risk, the perceptions of risks of GM crops will only exist in so far there is knowledge of them (Beck 2000:219). Knowledge is also placed centrally in discourses of education and sustainability (Scott 2001:129). The risk perceptions that education will deal with depends greatly on the knowledge about GM crops and how knowledge is constructed. The construction of knowledge about risks (whether perceived or real) is influenced by knowledge or unawareness (the lack of knowledge); uncertainty; the dominant knowledge system; cultural, value and belief systems and trust. These indicators are also the key contributors to risk perceptions or the lack of risk perception about GM crops.

2.4.2.1 Knowledge and unawareness

Knowledge or the lack of knowledge is not just a straightforward perception indicator. The various aspects related to knowledge and unawareness will be discussed here.

A lack of knowledge is often seen as the main reason for negative public perception about GM crops. Joubert (2003:5) states that a lack of understanding about biotechnology (of which GM crops is part) is providing a vacuum for unbalanced and often non-factual information, which has led to the confusion of the general public. Cockburn (2002:79) is of the opinion that consumers need to be more informed and Uzogara (2000:179) that public awareness needs to be increased.

The inability to supply information, especially to rural communities, will not only further encourage unawareness but also result in introducing a new source of inequality and thus social injustice (Rivera-Lopez 2002: 11). The inability to bring balanced information to rural communities about modern technologies like GM crops will widen the gap between the 'have's' and the 'have nots'. Sharma (2004:10) describes the divide that new technologies will bring, unless they address the real needs of the poor in their applications.

Atkinson, Green, Cowgill and Levesley (2001:96) are of the opinion that information about GM crops is sometimes used to raise public outrage. Public outrage is as a result of errors arising from a misunderstanding of the science involved. Atkinson et al (2001:96) express concern that activist groups might knowingly use incorrect arguments to agitate subsistence farmers. The source of knowledge greatly influences the bias and the effect.

Knowledge and unawareness are realised in conflicts of cognition (Beck 2000:217). More and more accurate knowledge is required, but more knowledge is becoming a new source of risk. As people learn more about GM crops, they can question the issue with greater insight. Unawareness on the other hand makes decisions, in a context where the outcomes are uncertain, very difficult. As Beck (2000:217) says this case can be applied to GM crops where neither the optimism of the proponents nor the pessimism of their critics is based on certain knowledge. Beck continues that there is no better breeding ground for risks than denying them. In other words by making lack of knowledge the foundation for action against risk would only open gates of fear and everything would then be perceived as risk.

A lack of knowledge seems to be the main reason why the public is confused about GM crops. People often do not know about GM crops because there is no information available. The sources of information can also have a bias and thus influence the perceptions in a specific direction. More knowledge does not necessarily mean a more positive perceptions towards the technology. More knowledge can lead to the more critical public questioning of modern developments like GM crops.

2.4.2.2 Dominant knowledge systems

Knowledge and unawareness raise the question as to what kind of knowledge is represented by either side of the GM crops debate. Proponents argue that concerns about issues like risks involved with GM crops are fundamentally irrational and anti-scientific (Millstone & Van Zwanenberg 2003:656). The Royal Society of Canada described the scientific communities' knowledge as rudimentary (cited in Millstone and Van Zwanenberg 2003:656). The opponents to GM crops claim that knowledge is socially constructed. Which is more reliable and more truthful? The core of the debate is often not about what GM crops are or are not, but is a matter of conflicting knowledge

systems. The epistemological framework in which perceptions is constructed must be considered as a key element that contributes to the debate.

Shiva (1993:9) highlights the fact that local knowledge has disappeared through its interactions with the dominant Western knowledge at many levels and through many steps. She states that Western scientific knowledge has generally been viewed as universal. She further elucidates that it is merely a globalisation of a very local and parochial tradition. This often led to the prefix of 'scientific' for modern systems, and 'unscientific' for the traditional knowledge systems. Thus more power was granted to modern scientific knowledge and encouraged the perception where science is given a specific epistemological status. The fact that modern science was determined through social meditation was ignored.

Cohen (1997:114) explains that societal support for science increases with scientific knowledge only up to a certain point, after which further understanding contributes to a decline in the favourability of public appreciation of science. Cohen stated three reasons for this observation:

1. As educational opportunities develop and become more available in societies, this has led to independent critical analysis and the propagation of alternative knowledge systems that challenge mainstreams dogmas.
2. Societies' scientific ethic has eroded.
3. During the past few decades science has been put to uses that have compromised its reputation as a virtuous and open knowledge system.

As a result of this it is not surprising that antagonisms between scientific and non-scientific epistemologies as portrayed by Shiva become so pronounced in periods following rapid scientific progress (Cohen 1997:114). The last two decades have been characterised by a scientific explosion in the field of biotechnology and that this is being challenged should come as no surprise.

Wolpert (Cited in Cothorn 1996:44) shows that there is a deep-seated fear of science. "Science is perceived as materialistic and as destructive to any sense of spiritual purpose or awareness." He continues that science is not constructed on a common sense basis, but requires a conscious awareness of the pitfalls of 'natural' thinking.

Scientists are seen as meddling with nature, as in the case with GM crops, and therefore regarded as callous to ethical and social implications.

Recognise the value of both scientific knowledge and socially constructed knowledge when dealing with a complex issue like GM crops is important. GM crops, as a scientific innovation, require a sound scientific knowledge base. However, it is an issue with many social and ethical complications. The need to recognise socially constructed knowledge in dealing with GM crops is imperative. These epistemological views have a direct influence on the perceptions of an individual regarding the use of GM crops.

2.4.2.3 Ethics and values, normative belief systems and culture

According to Priest (2003), cultural differences and policy priorities are particularly relevant to complex issues like GM crops. In South Africa, where there is a very heterogeneous society, food and food preferences vary within each cultural group. Risks presented by GM crops are perceived differently because of different cultural, value and/or belief systems. For example the opposition to GM crop technology in India is buttressed by various aspects of Hindu culture that question any 'tampering' with what it sees as spiritual links between humans and nature (Toke 2004:183). Vegetarianism's opposition is based on concerns about animal genes being spliced onto vegetables. In southern Africa GM crops is opposed because it is feared that GM crops will transform agricultural practices and that farmers will not be able to keep or exchange harvested grain for the next season (Nuffield Council on Bioethics 2004:51).

Toke (2004:182) said that public interest lies in the normative beliefs that underpin controversial scientific issues like GM crops. Therefore public perception is often primarily determined by a normative belief system. Non-scientific actors such as environmental groups are important in shaping dominant normative belief systems (Toke 2004:182). The normative belief systems that underpin the various scientific regulatory systems and the views of critics of those systems need to be examined.

Beck (2000:218) says that it is necessary to make a distinction between knowledge, latent impact and symptomatic consequences of risks. Knowledge about risks is tied to history and symbols of one's culture. This is one reason why the same risk is perceived and handled so differently in the political arena. A good example is the different way the

GM issue was handled in the UK and USA (Priest 2003). European politics give more credence to environmental voices, whereas in the USA they are more marginalised in policy discourse. The political acceptability of GM crops have become intertwined with the adoption or rejection of GM crops in parts of the world who seek to export agricultural surpluses (Priest 2003). Decisions made by developing countries about the choice of crops are likely to be influenced by the selection of crops that are approved by, for example, European regulations (Nuffield Council on Bioethics 2004:81). The perceptions about this issue are contextual and locally constituted. Moreover, perceptions are influenced by technologies such television, computers and the mass media.

The role values and ethics play, needs to be recognised as the latter permeate and impact environmental risk decisions. For example, an individual or group may hold certain perceptions on GM crops in an attempt to preserve the organic farming sector. Values and ethics provide a different view of the current reality and contribute to getting the big picture (Cothorn 1996:63). Risk is both a factual and a value statement (Beck 2000:215). Toke (2002:161) stressed that the values that impel people to take a pro- or anti-GM position are heavily dictated by social science rather than science. This means that risk statements can only be deciphered in an interdisciplinary manner where an equal measure of insight into technical know-how and familiarity with cultural perceptions and norms are applied.

Values, ethics, normative belief systems and culture are all very intertwined. Preferences may vary as to which crop is planted in terms of cultural food, agricultural practices, the value GM crops will be to a country in terms of export (considering international regulations) and merely a belief of whether it is right or wrong. The extent to which environmental educators' perceptions will be determined by this component, depends not only on their personal beliefs, values and culture but also on that of the context in which they work.

2.4.2.4 Trust

Priest (2003) summarises the GM crop debate by stating that opposition to biotechnology can be understood as a crisis of trust. This raises the question as to whom can be trusted regarding an issue like GM crops – science, industry, regulations, credible critical voices or the media.

More knowledge of genetic science does not mean better support for biotechnology. Trust can be a more powerful predictor to support biotechnology than knowledge according to Priest (2003). Priest further elucidated that trust in the institutions providing biotechnology to the public, overseeing these activities through regulations and pointing out issues from consumer and environmentalist points of view are crucially important. Wise individuals make decisions on the basis of the extent to which they trust those espousing different points of view. They look for various forms of expert opinion rather than trying to process all the raw data themselves.

According to Beck (2000:213) risk begins where trust in our security and belief in progress ends. Risk ceases to apply when the potential catastrophe actually occurs. Therefore the perception of threatening risks determines how we think and act regarding the specific risk. As long as there is trust in the progress, GM crops will not be perceived as a risk. This trust regarding GM crops can be extended to international regulatory bodies and governments' abilities to implement those regulations. The public seems to show more trust in international regulatory bodies such as the United Nations and World Health Organisation, than government agencies (Chen Ng et al 2000:112)

Trust is an important perception indicator regarding the use of GM crops. GM crops involve the scientists who develop the technology, authorities who decide on how to regulate it and the media and other communication bodies (like PUB) who have a role in informing the public. Within these sectors the public look for credible leaders whose opinion they can trust.

2.4.2.5 Uncertainty

Two key concerns are raised by anti-GM groups which relate to uncertainty regarding GM crops. The first is the fear of the unknown, like deadly micro-organisms or super plants that might be released. The unintentional effects of gene transfer, for example

unintentional gene transfer creates hard-to-eradicate superweeds, is the second concern (Uzogara 2000:188). Three aspects regarding the uncertainty about GM crops will be looked at.

Firstly, there is uncertainty about what we might be doing to our planet and we have to make decisions about these risks. A threatening future (uncertainty) contrary to fact is a parameter of influence for current action. Beck (2000: 214) states that “believed risks are whips used to keep the present-day concerns moving along at a gallop”. This is particularly true to the approach many environmental activists have used in dramatising potential risks of GM crops through the mass media, using it as an antidote to narrow-minded more-of-the-same attitudes.

Secondly, we are constantly confronted with opposing perspectives about the nature of risk. As a result neither the lay person nor the expert can predict with any certainty the consequences (Lacy 2002:45). Uncertainty in risk assessment can be used to cloud important issues (Cothorn 1996:63). Risk assessment often involves two different groups: cultural relativists who overemphasise the role of value judgements in risk assessment, and the naïve positivists who claim risks can be objectively measured (Cothorn 1996:63). Debates amongst these two groups often cause confusion and uncertainty among farmers and consumers of agricultural products (Russo 2004:9). As a result, a scientific proceduralism is posed where risks are not purely objective and the role of values must be placed into better perspective.

Thirdly, this leads to manufactured uncertainty, where not only the knowledge base is incomplete, but more and better knowledge often means more uncertainty (Beck 1999 cited in Lacy 2002:45). Manufactured uncertainty is often expressed as control and lack of control (Beck 2000:217). At the one pole of risk is the attempt to calculate unpredictable consequences through a repertoire of methods, i.e more control. At the other pole risk remains inherently undetermined and uncertain in its diagnosis. In other words, the more we try to confine and control risk, the more it broadens the uncertainties and dangers, giving rise to manufactured uncertainty, as is the case with GM crops.

Perceptions of uncertainty can be founded in incomplete knowledge. Opposing viewpoints about what is fact further deepens the confusion and uncertainty that exist

amongst certain groups regarding GM crops. More and better knowledge may not necessarily mean more certainty about the issue, but it may actually manufacture more uncertainty.

2.4.3 Linkage between the perception indicators

It is clear from the above discussions that none of the perception indicators operate in isolation. The indicators are linked at multiple levels. There is no specific study available to show how the perception indicators discussed in paragraph 2.4.2 are linked, although some links can be derived from the discussions. Kelley (1994) proposed a concept model about the public's views on genetic engineering which can provide some idea of how the factors that influence perceptions are linked.

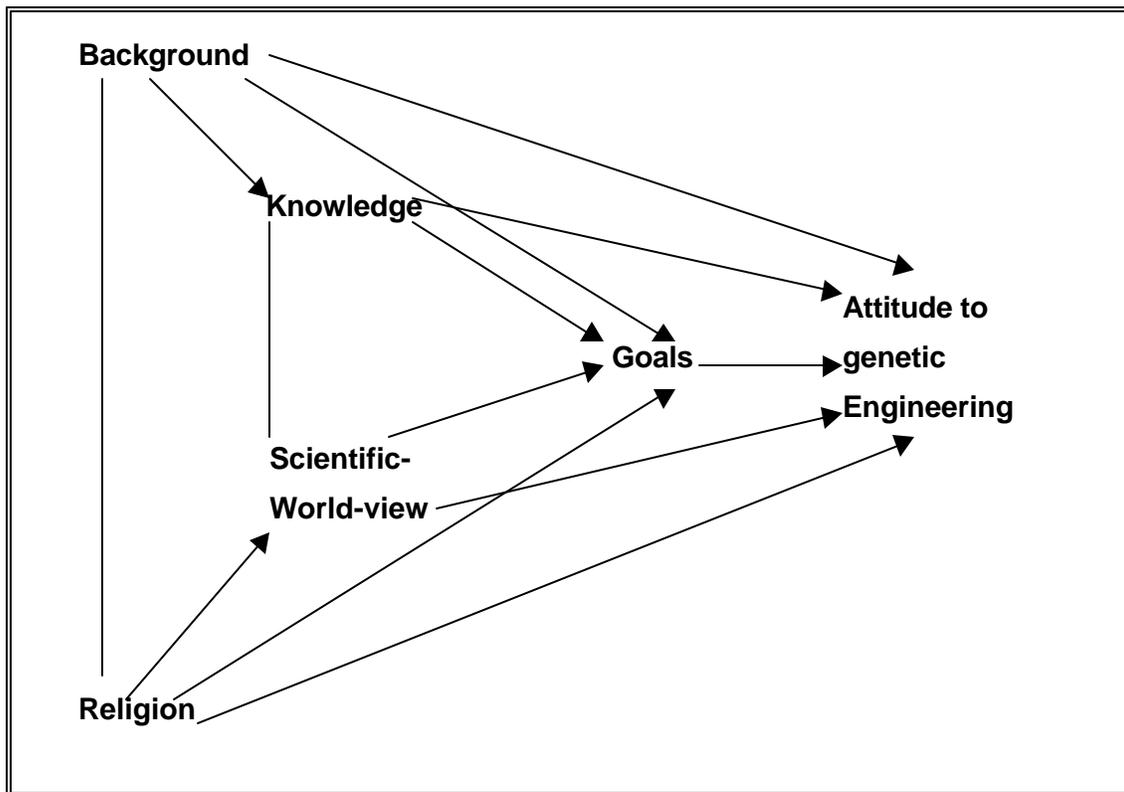


Figure 2.1 – *Concept model proposed by Kelley (1994) on the aspects that influence the Australian public perception of genetic engineering.*

According to Kelley (1994), the model assumes that age, gender, education, occupation, religion and other biographical variables can be taken as fixed. Knowledge about science and genetic engineering are caused in part by biographical variables. Holding a scientific world-view depends on both background variables and knowledge about the issue. What people think about the potential benefits of genetic engineering and how much they worry about the costs and risks involved depend in turn on background, knowledge and whether they hold a scientific view. All these factors are influenced by what they think of genetic engineering and whether they would use its products.

2.5 The response of environmental education to the GM crops issue towards sustainable development

The alarming future scenario of food insecurity, haunted by the possible risks of GM crops and the urgent need to address these issues, has placed education on the political agenda. Politicians and policy makers are becoming more and more convinced that education should play a crucial part in these societal changes (Postma 2002:41) where learners ought to be shown how they can contribute to the development of a sustainable world. Environmental education can be seen as a normative instrument to change the mentality and behaviour of citizens (Postma 2002:42). Postma (2002:43) questions the legitimacy of governmental claims concerning environmental education as the normative concept of sustainable development. By implication education should never be utilised as a means for creating some preconceived 'ideal society' (Postma 2002:55).

Postma (2002:53) reminds us that environmental issues are not initiated by politicians and policy-makers, but are placed on the political agenda by environmental activists and lobby groups of alarmed citizens. This re-emphasises the importance of the ongoing challenge of opposing perceptions in the GM crops debate. An ideal starting point would be to translate environmental educators' perceptions of the use of GM crops into implications for education. It will help to identify own biases when constructing and engaging in educational programmes towards sustainable development.

2.5.1 Environmental educators' perceptions

A global issue like GM crops is full of complexities and controversy as stated previously. Scott (2001:131) claimed that 'global environmental issues cut across scientific disciplines perhaps more than any other topic'. The GM crops issue cuts across various

disciplines and raise global environmental concern. The challenge is to create learning processes that can overcome the problem of cultural and methodological differences between these different disciplines (Borch & Rasmussen 2000: 485). Environmental education, as embodied by an association like EEASA, aims to promote interdisciplinary and multidisciplinary studies of the environment (EEASA 2001:1) and environmental issues.

Teaching is influenced by what educators know and feel and, in turn, they influence the learner's attitude (Weber et al 2000:29). This can be applied to educators at all levels and in all learning areas. Measuring perceptions of both educators and students is important because of the influence of one group on the other (Weber et al 2000:29). The indicators that determine the perceptions of an environmental educator of the use of GM crops will influence how he/she engages in teaching and learning processes regarding this issue. This study aims to ascertain whether the indicators that have been discussed in paragraph 2.4.2 are relevant to environmental educators' perceptions. If so, these can provide a guide to the implications for environmental educational processes.

2.5.2 Implications of environmental educators' perceptions on the use of GM crops

Some general implications of the perception indicators (discussed in paragraph 2.4.2) can be suggested, specifically in view of the Decade for Education for Sustainable Development. It is widely agreed that education is the most effective means that society has to confront the challenges of the future (UNESCO 1998:15). However, educators need to take care that education does not become normatively prescriptive as stated in paragraph 2.5 and imposing their preconceived ideals.

ESD, which is the process that environmental educators will engage with, can be used as a point of departure. Achieving sustainable development will depend upon a broader and a more participatory approach that challenges the actions of people in all walks of life. This will require changes in the way people think, live and work and is a call for actions to facilitate participation, awareness, education and to capacity building (Tilbury & Goldstein 2003).

ESD is defined by Tilbury and Goldstein (2003) as a process to motivate, equip and involve individuals and social groups, in reflecting on how we live and work, in making informed decisions and creating ways to work towards a more sustainable world. The roots of ESD are firmly planted in environmental education, which has long been recognised as an interdisciplinary and multidimensional approach to education.

Sustainable development requires a radical and critical questioning of ourselves and our motives, of the social bases of our actions, and of the implications and effects of these actions on others (Hattingh 2002:15). The approach towards SD has to transcend conflicting worldviews (Fien & Tilbury 2002:4) and challenge environmental educators to engage critically and contextually in the social processes of change (Firth & Plant 1996:198). This change can only be implemented where people are able to learn, feel and be empowered to act at a local level (Fien and Tilbury 2002: 6). As Buchanan (2000:162) said

...our principle priority must be in supporting people to improve their own capacity for practical autonomy. Instead of behavioural modification, it is time to start helping people become more mindful about their choices, become clearer about the value of a particular course of action, become more discerning and insightful about whether their initial inclinations might have been roused by misdirected motives, and become more conscious of collective responsibilities to create a just society.

When dealing with GM crops, amidst a myriad of complexity the environmental educator may find herself/himself equally confused but compelled to respond to GM crops as a global challenge. This can be quite overwhelming. Jickling (2003:25) suggests that environmental educators when confronting controversial issues, like GM crops in this case, should take the courage and confront the issues directly.

Thus, environmental educators must confront the GM crops issue and not avoid it. The process calls for a broader and a more participatory approach, involving different social groups. Moreover, the approach should involve the various disciplines concerned with GM crops and foster greater criticality to encourage practical autonomy which is empowerment.

2.5.3 Practical suggestions for the environmental educator

Controversial issues are often dealt with in the social sciences (Van Rooy 2000:21) and are seen to have educational goals like developing empathy, tolerance for others, healthy scepticism and social and political competence. These are also some of the core threads in the Revised National Curriculum Statement (Department of Education 2002:8) of South Africa where curriculum values such as social justice, healthy environment, human rights and inclusivity feature prominently. Presenting controversial issues to science students will allow them to unravel party interest and ideologies and enable them to make informed decisions about these issues (Van Rooy 2000:21). Applied to environmental education in the formal curricula, its purpose is to initiate learners and students into substantive debate and struggle about environmental issues like GM crops (Postma 2002:55). Learners should develop, strengthen and sharpen their ideas, opinions and arguments by gaining knowledge about the issue and by discussing it in heterogeneous groups, without moral limitations of this debate beforehand.

Jickling (2003:25) offers encouraging advice which can assist environmental educators grappling with controversial issues. These guideposts can be applied to the GM crops controversy and can help to tackle the issue head on.

Embrace ambiguity. Acknowledge that there are multiple realities of truth and reality. These create intellectual and practical space for creativity, thus stretching the way we think and helping to develop new emotions and ideas.

Avoid an action-orientated approach and become more inclusive of divergent ideas. We can become so confident and adamant about our own ideas that we are less inclusive of divergent ideas. We need to move beyond our own interests and perceptions.

Be fair. Do not end a discussion with your opinion or view but finish with the views from other perspectives. This will allow you to seek other perspectives actively.

Value controversy. GM crops is a complex and messy issue. Jickling (2003:25) writes that a vibrant democracy depends on our participation in these controversial issues although with careful preparation.

Be courageous. For education to transcend the *status quo* and to enable change requires risk. The good teacher will learn when to pull back and when to push forward.

Paragraph 2.5.3 discussed some of the principles that can be applied to education about GM crops. These are participation, critical thinking and empowerment. Implementing these will require a more open-process. Jickling's advice given in the above paragraph is

useful on how to foster these open-processes. This has particular relevance to environmental educators dealing with the formal curricula.

2.7 Conclusion

Environmental educators will require a critical and reflective approach to the GM crops issue. Such an approach would be built on the principles as outlined by Fien (1993:55) in paragraph 2.2. This chapter has looked at these in terms of a consciousness based upon:

- a) A holistic view of the issue - the interaction between natural and social systems
- b) A historical perspective of the current and future issues related to GM crops
- c) A study of cause and effects – examining both sides of the controversy.

Essentially the perceptions of the public and environmental educators are founded within a complex dualistic battle. The battle is about the possible risks and benefits – perceived or real. Knowledge and uncertainty, conflicting epistemologies, beliefs and value systems and trust further contribute to complex perceptions. These are also typical of modern risks as portrayed by Beck. This touches directly on this study which aims to determine if these are the indicators of environmental educators' perceptions. These indicators of perception can provide useful information for the development of educational programmes and initiatives to address the issues pertaining to GM crops.

The approach to address the issues pertaining to GM crops requires the development of critical thinking and problem solving skills, an appraisal of the ethics and ethical education and the development of political literacy through promotion of participation (Fien 1993:55) and the opening of discussions amongst all groups involved. It is necessary to understand the public perceptions and not to underestimate it, since science is a necessary but not a sufficient basis for governments' decisions (Scott 2001:136). From here, greater participation of small-scale farmers, improved mechanisms of dissemination of balanced information and development of locally appropriate schemes to give small-scale farmers a free choice as proposed by the Nuffield Council on Bioethics (2004:76) become more appropriate.

Environmental educators' key role in the implementation of sustainable development objectives cannot be over-estimated. Scott (2001:137) emphasized the importance of environmental educators' interaction with researchers, policymakers and other social groups. All groups must be open to mutual and shared learning, both to improve communication and to improve quality of results.

CHAPTER 3

Research design

3.1 Introduction

The aim of this research is to determine the *implications of environmental educators' perceptions regarding the use of genetically modified (GM) crops towards sustainable development*. In Chapter 2 the contextual and historical background of the GM crops issue was sketched. The chapter also outlined the basis of the controversy around GM crops. It highlighted the factors that contribute to the risk perceptions amongst the general public and raises the question if these can be applied to environmental educators as well. This chapter will describe how the indicators of perceptions regarding GM crops amongst environmental educators were determined. A qualitative study will allow us to understand social factors and the meaning that people attach to them (Poggenpoel, Myburgh & Van der Linde 1999:409). For this study structured open-ended interviews were used to generate the data regarding environmental educators' perceptions of the use of GM crops. Interviews were conducted at the Environmental Educators Association of Southern Africa's (EEASA) annual conference during April 2004. The implications of their perception on this issue will be drawn from the data when interpreting this perception. This chapter describes and explains the process and procedures of data collection and analysis.

3.2 Research question and sub questions

The main research question is to determine what are the implications of environmental educators' perceptions regarding the use of GM crops towards sustainable development. Firstly, it is necessary to establish what the perceptions are of environmental educators. To ascertain this, the following question was set:

What are the perceptions of environmental educators at the EEASA Conference 2004, regarding the use of GM crops towards sustainable development?

Initial sub questions were proposed which looked at some of the indicators that might affect environmental educators' perceptions from which the implications could be drawn.

These were:

- What do environmental educators know about GM crops?
- What is their opinion of the use of GM crops towards sustainable development?
- How do they see GM crops in relation to other biotechnologies?
- Do they see GM crops as a pressing issue in sustainable development?
- How does their perception compare to public perception surveys done by BUP?

To answer these questions, further questions were constructed which were used in this qualitative research study. The interview questions are shown in Appendix A.

3.3 Research method

The methods that have been used in other perception studies on GM (mostly food) are questionnaires (Kelley 1994; Asia Food Information Centre and International Services for Acquisition of Agri-biotech Applications 2001:9; Joubert 2001; Sittenfeld & Espinoza 2002:469; Cole 2003; Mucci, Hough and Ziliani 2004:4), a focus group interview (Kempen, Scholtz & Jerling 2003) and perception scales used by Weber et al (2000:28) to determine environmental risk perceptions. The enormity of the task involved in perception scales is beyond the range of a dissertation of limited scope. The researcher is of the opinion that the use of questionnaires in this specific study would limit the responses of the interviewees.

A qualitative research method was used to generate the data in this study. Structured open-ended interviews were conducted at the EEASA conference during April 2004 with nine environmental educators through purposeful sampling. The interview questions were piloted before they were used. Interviews were recorded and data transcribed. Transcribed interviews were analysed through phenomenological analysis. This research occurred within an ethical research framework.

3.3.1 Structured open-ended interviews

A structured open-ended interview is a systematic procedure to gather spoken ideas, information and opinions from participants (Monroe 2001:2) to determine how they perceive an issue, as in this case GM crops. Closed-ended questions, where a choice of response is given, may be used to record demographics. The purpose of this interview was to obtain rich and informative explanations offered to open-ended queries. Patron

(cited in Monroe 2001:3) says that interviews with programme participants or leaders are considered an important source of qualitative data. This qualitative data can be used to deduce implications for environmental education processes.

Prior to the interviews, the researcher needed to ensure the reliability and validity of the interview questions. The interview questions are explained in paragraph 3.3.3. The same set of questions was asked to each of the interviewees and the interviews were recorded with a dictaphone.

3.3.2 Validity and reliability

Validity: An structured open-ended interview was conducted with each of the purposively selected interviewees. A set of carefully worded questions was created for the interview. A higher level of validity of the interview questions was obtained through piloting the questions. The interview questions were piloted within the local area of the researcher. It was observed how the pilot interviewees responded to the questions, they were asked to comment on any ambiguities and adjustments were made. An external researcher was also asked to comment on the questions to improve the objectivity and validity. The set of 13 questions was narrowed down to six main questions, and the other questions were to be used as probing questions.

During the interviews it was ensured that each interviewee was at ease and he/she was allowed to talk freely. The researcher conducted the interviews in a quiet room or at a quiet place.

Reliability: Bogdan and Biklen (1992:48) state that in qualitative studies researchers are concerned with accuracy and comprehensiveness of the data. Therefore reliability is viewed as a fit between the recorded data and what actually occurs in the setting. The researcher would strive to ensure the reliability of data collected in the specific setting. The main questions to ask are: Is the sample representative of the target group (in this case environmental educators and particularly in southern Africa)? What is the position/bias of the researcher?

The EEASA conference was attended by 350 delegates, all environmental educators from a variety of fields within southern Africa. It would be difficult to get a more

representative sample of environmental educators. Although the sample employed in this study was relatively small, it put a critical spotlight on the urgency of the GM crops issue within environmental education.

The researcher is the main instrument through whom the data will pass and be processed. The prejudice and attitude of the researcher can bias the data (Bogdan & Biklen 1992:46) and perceptual filters may play a significant role, particularly in transcribing the interview by hand. The interviewer can display bias in seeing the interviewee according to his or her own view, or seek answers that support his or her preconceived notions or misperceptions of what the interviewee is saying. The reliability was improved by being aware of the researcher bias; ensuring that the research questions do not lean towards this bias and by recording of the interviews so that the information is not processed or filtered through the mind of the researcher. In this case the researcher holds a B Sc degree in Genetics and has been greatly influenced by his background knowledge.

3.3.3 Interview questions

The interview questions are shown in Appendix A. Questions 1 and 2 were asked to establish in which field the interviewee is working, his or her involvement in environmental education and to obtain some background information. Four other main questions were chosen, emphasising specific indicators that could influence the environmental educators' perceptions of GM crops. Sub questions were phrased for each main question and these were asked to prompt the interviewees to provide more detail in their answer, if it had not been elicited by the initial question.

Question 3 focuses on knowledge of GM crops. It also gives indication of the quality of the knowledge the interviewees have. The purpose of Question 4 was to ascertain the source where information on GM crops was obtained. Sources are often varied and biased and play a significant role in perception formation (see table 2.1).

The main research question deals with two concepts (GM crops and sustainable development) which are value laden and each may influence the other. Interpretations of sustainable development are value laden (Fien & Tilbury 2002:3) and Question 5 should give an idea of what value the interviewees prescribe to in terms of sustainable

development when dealing with or thinking about sustainability issues. The second and third sub questions would give an indication of the risk-benefit perceptions. Question 6 has a dual purpose: to get an indication of the affective or feelings towards the issue as well as establish the ideology to which the interviewees subscribe. Ideology greatly influences the type of knowledge the interviewees will value and how interviewees filter perceptual information. This can be depicted by how they view authority. The question can also reveal the level of trust the interviewees have in these authoritative structures.

In a more detailed analysis of other perception studies on GM crops and foods, a range of important factors were revealed. The summary thereof is shown in table 2.1.

Not all these indicators were specifically measured in the interviews. Many of these indicators are linked to each other. An open-ended interview will allow the identification of other indicators and to establish some links. All the indicators mentioned in table 2.1 was considered in the analysis of the data.

3.3.4 Sampling

During the period from 29 May 2004 to 2 April 2004, approximately 350 environmental educators from all over Southern Africa assembled at Treverton College in Mooi River Kwazulu-Natal for the Annual EEASA Conference. This group represented a cross section of environmental educators from the following areas:

- Formal education – primary, secondary and tertiary
- Non-formal education – adult community education programmes
- Informal education e.g. botanical gardens, aquariums (although these may run programmes for formal education)
- Policymakers e.g. NEEP workers and the Minister of Education's advisor on environment
- Environmental educators working in public services e.g. municipal areas
- The whole southern Africa (Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe)

The EEASA Conference provided the ideal platform for the selection of the sample group to be representative of environmental educators. This is the only time during the course of a year that such a cross-section of environmental educators from southern

Africa assemble. Other gatherings may occur within a region, representing smaller sub-groups. In the immediate area of the researcher no such gathering has yet occurred.

At the conference the researcher presented a paper, entitled *GM crops in developing countries: possible implications for education towards sustainable development*. The content of the paper is partially outlined in Chapter 2 of this dissertation. A group of approximately 40 people, from the total group, voluntarily chose to attend the presentation. At the end of the presentation several people took part in the 40 minutes discussion.

For the purpose of the interviews it was necessary to identify people who had an opinion and some knowledge on the subject of GM crops in order to contribute meaningfully. Therefore a purposive sampling technique was used. Environmental educators who attended and participated in the discussion on GM crops were identified for the interview. A group of 12 representatives from the group were purposefully selected. Unfortunately only nine environmental educators were interviewed because three people left the conference early. Two of these interviews could not be transcribed due to technical problems.

Due to the geographical isolation of the research, it became problematic to conduct further interviews. Additional interviews would take place in a completely different context and therefore difficult to control. Moreover, the researcher is of the opinion that extended data generation was beyond the requirements of a study of limited scope.

3.3.5 Ethical measures

Bogdan and Biklen (1992:54) suggest four ethical principles applied to basic research.

1. Protect subjects' identities so that the information you collect does not embarrass or harm them in other ways. Maintain anonymity even in the relay of verbal information about the individuals to others, particularly people who may use the information in political or other ways.
2. Subjects need to be treated with respect and their cooperation in the research needs to be established. It needs to be explained to interviewees that they enter the research project voluntarily and their informed consent is necessary.

3. Honour the terms of agreement and be careful as a researcher to be realistic in such negotiations.
4. Tell the truth when writing the report findings and do not fabricate or distort data.

Informed consent of the interviewees was obtained and it was explained to them that data is collected for this research and that their identity would remain anonymous. Interviews were conducted in a quiet public place, allowing them to relax and to focus.

3.4 Data processing and analysis

The data generated from the interviews was transcribed. The transcripts of interviews were analysed as follows:

In order for the interviewer to understand what each interviewee said, rather than what each person was supposed to have said, bracketing was used.

Subsequently the entire tape was replayed several times by the interviewer to make a sense of the whole and to provide a context for the emergence of specific units of meanings and themes.

The researcher scrutinised the information and delineated units of general meaning. These units were noted and reduced to units of meaning relevant to the research question. Codes were developed and used to refer to the aspect or indicator of perception that is portrayed by specific phrases.

The lists of relevant meaning were checked and those previously mentioned were eliminated as redundant. Units of relevant meaning were clustered together according to the codes used. From the clusters themes were determined by examining the meanings of the clusters. A theme is what expresses the essence of the cluster.

General and unique themes from across all the interviews were determined, i.e. what is common to most interviews and what is unique to a single or minority of interviews. Themes were contextualised and the researcher wrote a summary of all the interviews to capture the perceptions accurately. From this information conclusions were drawn.

In the analysis of the data the validity of the research can be enhanced through actively searching for evidence that contradicts, as well as confirms the explanations being developed (Clarke 1999:533). Training external researchers to verify the units of relevant meaning will contribute to the validity of the data.

In the analysis of the interviews the researcher attempted to ensure that the meaning of what the interviewees said was achieved. After interviews were transcribed the researcher listened several times to the interviews and read through the transcripts.

3.5 Conclusion

This study aims to determine the perceptions of environmental educators regarding the use of GM crops towards sustainable development, and then to determine what implications this holds for environmental education. A structured open-ended interview was used to generate the data.

This study requires more insight and understanding (greater depth) of the complexities involved in perceptions of GM crops. Most of the previous perception studies on this issue were opinion poles often used by the scientific fraternity. Restricted answers required by questionnaires does not allow for the respondents to clear misunderstandings, considering, for example, the variety of educational and cultural backgrounds that exist within southern Africa. Interviews allow interviewees to speak more freely and they are not just restricted to the options provided by the researcher.

Structured open-ended interviews provide a framework within which the interviewee can respond freely. The limits of the interviewee's knowledge can be tested, it encourages greater co-operation and helps to establish rapport and provides a truer reflection of what the interviewee really believes. It also allows for unexpected or unanticipated answers.

Interviews provide a rich data source from which the implications of environmental educators' perceptions on the use of GM crops towards sustainable development can be drawn. The next chapter provides a summary of analysed interview data.

CHAPTER 4

Research findings

4.1 Introduction

The structured open-ended interviews with environmental educators provided a rich source of qualitative data. The transcribed interviews were analysed to determine the perceptions of environmental educators regarding the use of GM crops towards sustainable development. The interview questions had to ascertain the understanding of the two key concepts in the research question: GM crops and sustainable development. It also aimed to establish how environmental educators see the relationship between GM crops and biotechnology, as well as how serious an issue GM crops is in sustainable development. The interview responses showed a link between environmental education, GM crops and sustainable development. The analysed data revealed eight general themes and four unique themes. One of the general themes revealed that environmental educators viewed GM crops as a serious issue, though no explicit relationship between GM crops and biotechnology was shown. The other general and unique themes can be related to indicators that affect perceptions as shown in table 2.1.

4.2 GM crops, sustainable development and environmental educators

The relationships between GM crops, sustainable development and environmental educators were described in Chapter 2. The interviews with environmental educators confirmed the relationships that exist between environmental educators, GM crops and sustainable development. The interviews also revealed environmental educators' understanding of the concepts 'GM crops' and 'sustainable development'.

4.2.1 The context of the environmental educators interviewed

The environmental educators who were interviewed came from a variety of fields: formal (e.g. home economics inspector for the Ministry of Education) and non-formal education (e.g. Department of Agriculture and Environment) and non-governmental organisations (e.g. Botanical Gardens).

The programmes and projects that they are involved in range from research and teaching, co-ordination and networking of public awareness programmes, training and policy implementation, capacity building programmes for eco-clubs and community

groups, and management. Several environmental educators are involved in policy making and implementation (e.g. Social Development Authority supporting implementation of the Convention on Biological Diversity), academics and community based natural resource management.

Environmental educators are involved in cross-cutting issues like biodiversity, environmental management issues, food programmes for orphan children, food gardens and agriculture to name a few. These issues require a multi-disciplinary approach. The programmes aim to address MDG like food insecurity, poverty alleviation and biodiversity protection, which are fundamental to sustainable development. The GM crop debate also revolved around these issues. Environmental educators' perceptions on the use of GM crops towards sustainable development pivots on their understanding of the concepts 'GM crops' and 'sustainable development'.

4.2.2 Environmental educators' understanding of GM crops

The concept 'GM crops' seems to be reasonably well understood by environmental educators interviewed. Descriptions of GM crops range from mostly socially constructed conceptions like " food crops that are changed through human intervention by technology" to scientific definitions "where certain genes either from the same species or from species or families outside of that has been brought in or incorporated into the genome to produce a different variety". However, there have been some misconceptions such as "food with some medically scientific working in them" and some environmental educators described GM crops as "hybrid seeds" and "products of cloning". The general understanding has been more socially constructed than scientifically because as one interviewee puts it, "I am not a scientist". No link with biotechnology in general was revealed from the interviews.

4.2.3 Environmental educators' view on sustainable development

Several initial responses like "a loaded question", "worrying that there are many different definitions" and "that's a good question" has confirmed that sustainable development is an ambiguous and value laden concept. A much clearer understanding of sustainable development exists amongst environmental educators than the concept GM crops. The general understanding is based upon the *Brundtland Report's* (1987) definition that it is a kind of development that aims to meet the needs of the present generation without

compromising the ability of future generations to meet their own needs. Sustainable development has been defined contextually differently for as one interviewee stated that “somebody’s needs in a rural community can be different from somebody’s needs in an urban area”. Referring to community based natural resource management, an interviewee viewed sustainability as “been based upon utilisation, not just preservation, not just locking up fauna and flora in a national park, but also allowing the consumption of those with the philosophy by doing that things become more sustainable because there is more control on it”.

Several interviewees stressed that sustainable development entails “people being empowered in their own context” and that it is “a development that doesn’t compromise the quality of life”. Concerns were raised about the strong economic approach that drives sustainable development and that “ethics need to be looked at very closely”. These concerns were raised in the context of poverty alleviation and food security issues.

4.3 General themes

General themes are the themes that were common to most interviews. These include the following: the seriousness of the GM crops issue; the urgency to address needs in terms of food insecurity and poverty; ignorance and the lack of information; the uncertainty that exists about GM crops; the effect of information sources; trust in rational frameworks and the bias and responsibility of authorities.

4.3.1 GM crops a serious issue in terms of food security

GM crops are certainly regarded as a serious issue by most interviewees. Some express the importance of this issue “particularly in a southern African context” and as an issue “that we have to deal with in this particular decade”.

In southern Africa GM crops are viewed as a serious option in this decade, particularly when dealing with food security issues. Issues like “seed and quality of seed”, “access to indigenous crops”, “the value of indigenous crops”, “other options and the variety of other options” and “where one can buy seed from” seem to be key concerns. The contextual relevance of GM crops was further articulated by an interviewee stressing that “persistent drought conditions in most of southern Africa, with 13 to 14 million people on the brink of starvation and various governments not allowing GM products to

come in, in terms of humanitarian assistance, I think it was raised to quite a high priority and certainly got a lot of publicity”.

Linking GM crops to food security another interviewee expressed concern that “you can’t operate when your risk levels are high”. Food security is a serious issue and “you need to be more cautious rather than pushing the risk element. It’s too serious an issue to mess with and to try and play with”.

Some interviewees felt that they are “going to put GM’s high” on their lists of concerns with regards to sustainable development. Others feel that “there is a sign of this seriousness because we are attending most of these meetings” and have a “bio-safety coordinator” from a governance point of view.

4.3.2 Needs

The needs for GM crops depend on “what is in demand” especially when it comes to “survival of people” and crops being “harvested for human consumption”. In some southern African countries, as one interviewee stated, “we are still fighting hard to actually meet our food security needs”. “People’s needs will tend to vary from place to place” and we are “trying to make people cope with their own situation where they exist”.

An interviewee said that they are currently doing a needs assessment on GM in their country to ascertain “what information is there, what expertise do we have in the country, how much impact GMO’s have on the ground, how much demand is there for these products on the ground”. This will enable “us to “draw up our plans and action plans”.

4.3.3 Ignorance and lack of information

There are several aspects that are revealed from the interviews that relate to knowledge and information. The lack of information, unawareness about risks and benefits of GM crops, a lack of understanding and the need to be more and better informed.

Firstly, in certain southern African countries interviewees are of the opinion that “there is absolutely nothing or little known about GMO’s” and that information on GM crops “is not very common”. Very little information about GM crops has been disseminated to rural

communities for an interviewee stated that, “not much information has been distributed to communities about GM crops”.

The availability of little or no information on GM crops created the problem of the lack of understanding. Where people in drought stricken areas “receive food handouts and supplements like maize and beans...and they will begin to cultivate these” seeds, they are unaware of the long term effect that it may have on the ground or the environment. There seems to be little clarity on the benefits or the risks involved with GM crops, as an interviewee stated that “most of the end users of some of these products are not aware of possible safety issues”.

Some interviewees felt that they did not “understand it at first” and that they “know a bit about it but not everything”. This created a need “to be more aware of” and keeping “up to date”, therefore having “to do more reading and research” about GM crops.

4.3.4 Uncertainty

Uncertainty regarding GM crops relate to the benefits of GM crops, the long term effects on the environment and to humans in terms of the risks. This uncertainty makes it difficult to manage and to communicate information about it.

There seems to be a vague understanding of the benefits of GM crops, and as one interviewee stated “GM crops can be an answer maybe but that does not mean that there are no problems”. Interviewees suggested that GM crops are “closely linked to food security issues and the risks are not clear”. The risk factor also raised the questions as to whether “we are quite sure that we can manage those risks... that’s the fear, it’s the unknown”.

An interviewee felt that biotechnology (GM crops) is not popular with communities because “most of the people will raise a lot of questions and try to get some clarity on why is it done, how is it done, what are the benefits and advantages of such crops”. Interviewees expressed concern about looking only at the advantages, because people “forget about the long term impact of technology which could be harmful to our nature, environment in general and the people themselves”. The line between taking the risk or to show caution is defined as responsibility, and “you can’t really define that line”. This

leads to the fact that people (particularly decision makers) are “confused about whether or not these products are to be allowed to come in” their country.

4.3.5 Information sources

Some environmental educators who raised many concerns about GM crops seem to obtain information from “activists’ information” sources. *Safeage* a “radical group” is perceived to be “quite well informed”, because “they looked at a number of different case studies from overseas countries such as India”. In contrast, an interviewee with a strong pro-GM crops bias “has worked in plant breeding for many years”. A source like *Farmers’ Weekly* is perceived to be a good source of information as it “does a very balanced job because they point out the strong points particularly to small farmer women that use GM enhanced cotton but they are also quite willing to publish critiques on this or people who have diverse opinions”.

Environmental educators have a need for balanced information and many interviewees rely on newspaper articles and the Internet, in particular websites of UNEP and sites that relate to the ‘Cartagena Protocol on Biosafety’, to obtain balanced information. They felt that this information “is pretty comprehensive” and is “properly outlined for GMO’s”. Other sources like “a publication by FAO...called *The Green Book* ...I found very helpful just to give a good balanced background about GM”.

4.3.6 Trust in rational frameworks

Environmental educators seem to place their hope in rational frameworks like the ‘World Food Programme’ and divisions of the United Nations which address GM crops in poverty and food security programmes. The ‘Cartagena Protocol on Biosafety’ under the Convention of Biological Diversity, seems to not only offer reliable information, but is seen to “provide the necessary tools to control this particular issue” (GM crops), guiding people on the ground who are dealing with it. Environmental educators are of the opinion that authorities’ commitment to this protocol is the beginning to ensure safety about GM crops for their people.

4.3.7 Authorities’ bias

Several environmental educators “don’t like what the authorities are doing” and are of the opinion that “government has not been too clear or too transparent” about the GM

crops issue. The progression of GM crops “is being propagated by multi national organisations or cooperations” and governments are “allowing big business, large seed companies to dictate” and “influence decision making”. This infiltration seems evident from the fact that “the policy does not seem to favour the populations but they favour propagators of genetically modified crops”. This approach to “sustainable development is really an economic approach to development”.

A strong opinion is expressed that governments “don’t do enough in terms of informing the public and educating the public”. Governments are “pushing a particular line” and “the other side of the story is silent...so you get this marketed message”. This equally applies when solutions to address poverty and food security problems are sought, therefore they “have to look at some of the other methods that can help alleviate some of these problems”.

4.3.8 Authorities’ responsibility

Environmental educators stress that “government is not playing its social responsible role”. “They have a responsibility to society to make responsible policies” through a “more democratic” process.

“A responsible authority” should “be represented not with an individual view of the person representing a particular group but mandated by people from the ground” and “presenting both sides of the story”. This will allow the public to make more informed decisions. For example “allowing the public to choose...by labelling what is GM or what is GM free”. Their responsibility is “not just branding and marketing and financial spin offs...but about lives and the health of people”. “The justice issue...is possibly the key point which needs to be looked at very closely...environmental and social justice first before one gets to sustainable development”.

4.4 Unique themes

Unique themes are those themes that are unique to a single or minority of interviewees. Four unique themes were identified from the interviews with environmental educators that may pertain to their perception on the use of GM crops.

4.4.1 Language and terminology

An environmental educator stressed the important fact that “the expressions or terminology that is used in genetically modified organisms, those things are not in our indigenous language”. “On the one hand we are trying to grapple with the ideas that are involved and on the other hand we are grappling with the situation that these things are alien to our own indigenous language”.

4.4.2 Knowledge systems

An interviewee mentioned that there are different forms of reliable information. Perception depends on “what you mean by reliable information”. Scientific knowledge is seen as reliable because “scientific researchers who are working on biotechnology research would document their findings’ reliability based on the methodology that they are using”. This information “is sometimes naively used” and seen as the only source of reliable information. “Activist information” is also reliable information, although it is “a bit different form of information; it forms more of a socially critical orientation rather than a sort of scientific method orientation”. The two types of knowledge systems are not seen as an either/or option but as “equally valid and reliable”.

4.4.3 Societal structure change in southern Africa

One has to consider some of the unique situations in southern Africa. “The amount of importation they have to do just in order to sustain themselves not counting the humanitarian aid...and it seems like that there is some sort of disaster...at all times...floods or droughts, wars”. The progress that can be made in “straight line genetic plant breeding...is 10 –13 years before you really have a variety you can put out to the market”. This complex situation is compounded by the fact that in “southern Africa ...the youngest are taking care of the oldest now”. It is a “whole new terminology that’s come into play - child headed households” and the “labour force to do traditional farming is just not there”. GM crops may well “fit a niche for what we have got in the rural areas now in terms of the older people and younger people”.

4.4.4 Interest change

The increased media publicity and information available contributed to a change in interest in GM crops. An interviewee stated: “I have heard about it but I didn’t take much notice of it” but after attending an information and discussion session on GM crops, “I will

have more interest on it". A change in interest and the priority placed on GM crops were evidently the outcome of increased information/knowledge.

4.5 Conclusion

Environmental educators' view on the use of GM crops is more socially constructed than scientifically constructed. This is emphasised by their understanding of the concepts GM crops and sustainable development. GM crops are seen as a serious issue in southern Africa in view of food security and poverty alleviation. The situation is unique and complex and societal structures are changing. Other factors that pertain to the perceptions of environmental educators are: the lack of information available, the bias of information sources, uncertainty, trust in rational frameworks, authorities' bias and responsibility, language and terminology and different knowledge systems. The next chapter will address the research questions, drawing on this data. In addition, the factors elicited from the interviews will be discussed in relation to the literature review in Chapter 2.

CHAPTER 5

Discussion and conclusions

5.1 Introduction

This chapter will discuss the results shown in Chapter 4 and the information will be used to draw conclusions. Firstly, the findings of this study will be compared to the issues that were discussed in the literature review in Chapter 2. The relevant aspects are the context of the GM crops debate in southern Africa and the indicators that influence perceptions, in this case applied to environmental educators. The relationship between these indicators will be shown in a hypothetical concept model. This chapter will further discuss unexpected findings and the limitations of the study.

Conclusions are drawn and discussed in the form of answers to the sub research questions. These questions in turn provide the basis to answer the main research question: what are the perceptions of environmental educators regarding the use of GM crops towards sustainable development? Implications for environmental education can be extracted from the answers to the sub questions and the main question. The chapter concludes by making recommendations for future studies, considering the limitations and findings of this study.

5.2 Relation between findings and issues in the literature

The study of environmental educators' perceptions of the use of GM crops towards sustainable development showed several similarities with other perception studies on GM crops and issues. A summary of the literature that has been studied with regards to perception of GM crops and GM related issues revealed twelve indicators that influence the perceptions thereof. From this study, eight indicators can be related to these twelve indicators. A concept model is constructed to show how these indicators can be linked and may affect the other. The context of how GM crops are viewed in southern Africa is very different to perception studies in other parts of the world.

5.2.1 The context

The context in southern African was not identified as a general or unique theme, as the interview questions were not designed to compare the southern African context with the context of the GM debate in other parts of the world. Consequently no specific data was gathered in this regard. The southern African context was discussed in significant detail in the literature review in paragraphs 2.2.3. and 2.2.4.

Although there were no specific questions referring to the context, it is worth noting that the environmental educators referred to several aspects of the uniqueness of the southern African context. These were mostly socio-economic aspects rather than specifics about the bio-physical conditions. The aspects related to the context in southern Africa referred to by environmental educators interviewed are grouped as follows:

Poverty and food insecurity

Poverty and food insecurity were frequently mentioned as issues when sustainable development and the needs of people in southern Africa were discussed. Interviewees stated that poverty and food insecurity are very real as they are frequently faced with the needs of poor and hungry people when they endeavoured to involve them in programmes and projects. An interviewee summarised the dilemma of poverty saying that “if people are hungry, they will eat rotten maize” and whether maize is GM or non-GM is completely irrelevant.

Needs of people

The needs of people within southern Africa differ from one area to another. It is also significantly different from other parts of the world where perception studies on GM crops have been done. Assessing the needs within communities (Engleson, Grover, Hottman, Gomoll & Grady 1994:3) and addressing the basic needs, is paramount to progress in an environmental educational programme. The needs in rural and urban areas are also significantly different. Rural people are much more dependent upon agriculture for their livelihood. Planting suitable crops that yield a large enough harvest to meet their basic needs is essential. Rural people are dependent upon a high yielding low input crop for their daily livelihood, explained in paragraph 2.2.3. To the urban dweller the relevance of

GM crops revolve around a fashion choice to buy products derived from GM crops or a non-GM product in a range.

Changing social structures

Changing social structures compound the situation in southern Africa. Child-headed households have become more common and the traditional labour force is absent due to HIV/AIDS. This creates a need for a more efficient means of food production for people living in rural and agricultural areas. Environmental educators interviewed express that GM crops can fill this gap.

These issues have created a complex political situation. The politics around human health or the environment can sometimes be jeopardized when no formal precautionary measures are taken or when action is blocked, according to Conko (2003:5). A good example is the situation in southern Africa during 2002 where some governments who have not allowed humanitarian aid in the form of GM seeds, while there are millions on the brink of starvation within that country. Conko (2003:5) said that one is left to wonder what measures should be used to ward off which risk in application of the precautionary approach. The Nuffield Council on Bioethics (2004:80) made several recommendations how the international fraternity can deal with the complications involved in GM crops regarding food aid, intellectual property rights and governance issues.

A valuable observation from the data described in paragraph 4.2.1 must be noted here. The issues that environmental educators are involved in cut across several disciplines and require a *multi-disciplinary* approach. The unique and complex context of southern Africa is understood by environmental educators interviewed. They perceive the context in southern Africa as socially, economically and politically complex when discussing the use of GM crops towards sustainable development. Poverty and food insecurity are key concerns and the basic needs of communities need to be addressed. The changing social structure of communities and strong political complications are key contextual concerns with regards to environmental educators' perceptions of the use of GM crops towards sustainable development.

5.2.2 Expected findings

Table 2.1 showed twelve aspects that affect perceptions of GM crops/foods derived from previous studies. These indicators were expected to emerge in this study. Table 5.1 shows which of these indicators were elicited from the data of the study of environmental educators' perceptions.

The indicators of perception found in this study compare well with those of previous studies. However, these indicators were revealed within the specific context of southern Africa, and the same value cannot necessarily be attributed to them as in other parts of the world.

Table 5.1 – *Indicators of perception from previous studies also revealed in this study*

Perception indicator from previous studies	Indicator revealed in this study
Knowledge	Environmental educators interviewed appear to have a low level of scientific knowledge about GM crops often because of the lack of information available on GM crops. However, they have sound socially constructed knowledge of GM crops.
Information sources	Information about GM crops comes from a variety of sources e.g. Safeage (a radical anti-GM crops groups) and FAO (who is more towards promoting GM crops).
Risk-benefit analysis (Not specifically shown in data)	Considerable concern about GM crops was raised but the understanding of the benefits and risks remain unclear.
Trust	Trust in rational frameworks like the UN to provide guidelines.
Knowledge systems	There seems to be two different knowledge systems – scientific and socially constructed. Environmental educators interviewed have more socially constructed knowledge dealing with multidisciplinary issues.
Uncertainty	Uncertainty about the effect of GM crops on the environment and human health, as well possible risks and benefits thereof.
Culture, values and beliefs (Not specifically shown in data)	Culture (tradition) of the agricultural based lifestyle of rural people in southern Africa, and values more in terms of basic needs were revealed.
Language	Language and terminology particularly in rural communities is a major obstacle.

5.2.3 Link between perception indicators

The aspects that determine perceptions of environmental educators are not individual items but are interlinked. Chapter 2, paragraph 2.4 4 showed a concept model that was proposed by Kelley (1994) indicating how the different factors that determine the perception of the Australian population on genetic engineering (a more general topic

than GM crops) were interlinked. Using this as a basis, a concept model for the aspects that determine environmental educators' perceptions of the use of GM crops towards sustainable development can be useful to illustrate a possible link between the different indicators. This model is a hypothetical model of how the different indicators can be linked, drawing from the literature review and data. Another investigation in a larger sample needs to be conducted in order to make any specific deductions.

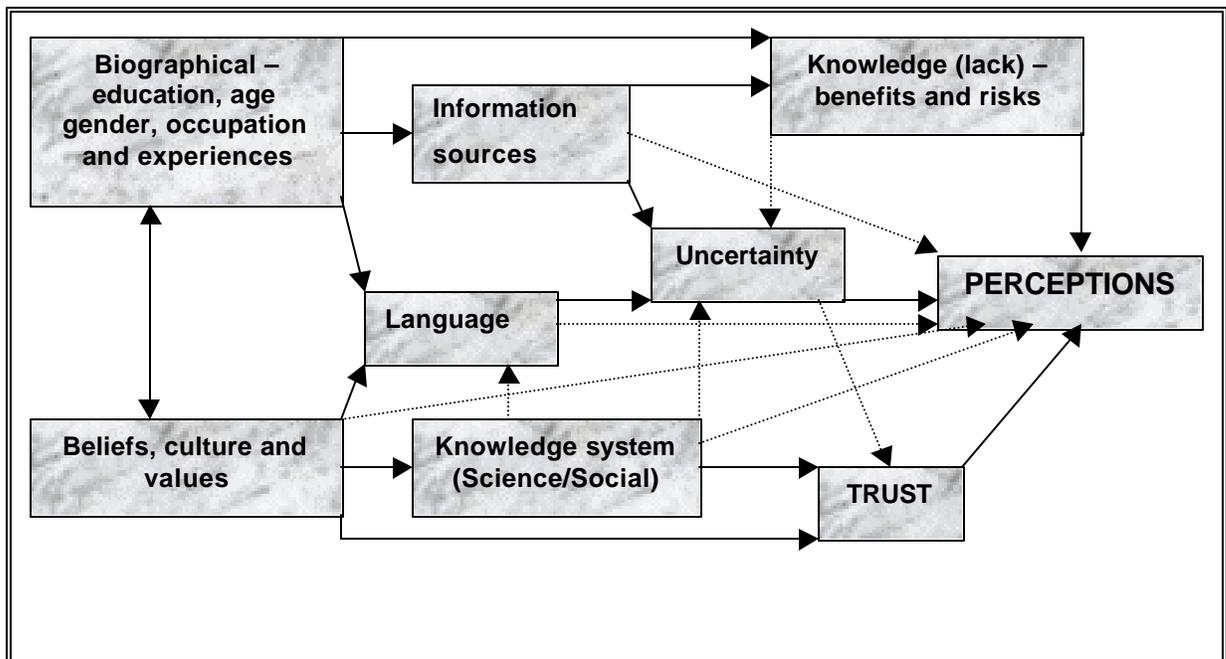


Figure 5.1 – A concept model to show the indicators and the relation between the indicators that influence environmental educators' perceptions of the use of GM crops

GM crops involve very complex and controversial issues. As a result the perceptions are not determined by a single indicator or a linear sequence thereof. The indicators are interlinked and possible linkages are described below.

The biographical data of the environmental educators including factors like age, gender, education and experience were not revealed by this study, but are important determinants in other perception studies (See paragraph 2.4.1). These in turn, are strongly entrenched in the belief, culture and value system of a specific community as discussed in paragraph 2.4.2.3. Rubin and Linturi (2001:275) state that the general and social knowledge that an individual reaches for and possesses is reflected and filtered

through his or her identity and personality. Personal identity is constructed from a variety of characteristics like age, gender, talent, skill and profession. Beliefs, ethical ideas and values form the fields of social knowledge (Rubin & Linturi 2001:274). This social knowledge is gained from the experienced world and from other people who live and have lived in this world. The biographical factors and belief, culture and values form the basic preferential filters that determine which information sources will be chosen by a specific group, how the language is constructed and how the knowledge system develops.

Knowledge about the benefits and risks of GM crops is greatly determined by what has been the source of information (paragraph 4.3.5) as well as biographics. Where information derived primarily from scientists in the genetics field, have been the main source of information, a more positive perception regarding the use of GM crops is held. Where activist information has been the main source of information, a perception of the risks of GM crops seems more evident. This in turn affects the certainty with which environmental educators perceive GM crops as a solution to food insecurity and poverty issues.

Uncertainty around the GM crops controversy seems to be the biggest stumbling block to policy makers (Millstone & Van Zwanenberg 2003:658) and environmental educators. Knowledge about GM crops, the type of knowledge and information source (where it is available) greatly affect the uncertainty pertaining to the acceptability of GM crops. The amount of uncertainty surrounding the GM crops debate has led to a perception of lack of trust in scientists and authorities.

These indicators will be drawn upon when the implications of environmental educators' perceptions regarding the use of GM crops towards sustainable development are described in paragraph 5.6.

5.3 Limitations and unexpected findings

To determine environmental educators' perceptions in a specific context, this study was limited to the EEASA Conference. A structured open-ended interview was used to obtain data, therefore not seeking specific answers. The study showed several limitations in the data when compared to a series of other studies. However, when compared to individual

studies, it becomes a rich data source. This section highlights the limitations to the study in comparison to a range of other studies on perceptions of GM crops and foods. Recently there have been a few studies that focus only on GM crops, instead GM crops are often studied in the broader framework of biotechnology.

5.3.1 Limitations in this study

There are several indicators from the combination of other studies which were not revealed by the results of this study. These are biographical data, preferences based on interests for example, emotions and more explicit indicators about the belief, culture and value systems.

Biographical data

Gender, level of education and experience with GM crops were aspects of biographical data that were identified in other studies (See table 2.1). A survey done on a larger sample, using structured questionnaires, would have been an appropriate method to obtain this type of data. However, some biographics (paragraph 4.2.1) were identified during interviews, mainly regarding the field of work in environmental education. This was to determine whether the interviewees are involved in a field of environmental education, which area of environmental education and whether their work depends on a knowledge of GM crops.

Most environmental educators interviewed do not deal directly with GM crops, but with multi-disciplinary and cross cutting issues that affect or may affect the environment such as food security. GM crops have been relevant to some the environmental educators particularly in their dealings with agriculture and food insecurity issues.

Preferences

Preferences as perception indicators were not specifically identified in this study. Preferences come into play where there is a choice for the consumer or the farmer who buys maize. In southern Africa there is no choice to the consumer in terms of GM or non-GM products as these are not distinguished or labelled. A farmer planting crops (where GM varieties are available) should have the choice if it is offered to him. This is one of the greatest challenges presented to the environmental educator. Many rural people do not know what GM crops are and hence cannot make informed decisions

about them. As a result environmental educators are faced with a dilemma of a knowledge and language vacuum.

Emotions

GM crops are a contentious issue and arouse intense emotions. Proponents of GM crops often claim that the GM crops controversy is sensationalised by the mass media and that it represents an emotional reaction. This study did not specifically measure or determine the extent to which emotions are involved in perception formation.

Beliefs, values and culture

Chapter 2 paragraph 2.4.2.3 highlighted the important role beliefs, values and culture play in perception formation. During the interviews no specific questions were asked to determine the value, cultural or belief system that underpins the position a person holds on GM crops. References to these have been made in answering questions on sustainable development (interview question 5) and on authorities (interview question 7). The researcher was of the opinion that asking environmental educators how they view authority would provide sufficient information on the ideology that they subscribe to. The way authority is perceived did not provide sufficient information on both the cultural and belief systems. A question such as “Do you think it is right to have GM crops or is it natural?” may have elicited interviewees to better information on cultural and belief systems.

Link with biotechnology

The study revealed that the environmental educators interviewed understanding of GM crops shows no link between GM crops and biotechnology. A lack of clarity exists about the concept biotechnology in general and how specific fields within biotechnology like GM crops relate to it. Modern biotechnology is a reasonably young development in southern Africa and this link is not well understood by the general public (Joubert 2003:2). Public Understanding of Biotechnology (PUB), a South African initiative to raise awareness of biotechnology is making an effort to improve the understanding of GM crops in relation to biotechnology in general.

In addition to the above limitations, this study comprised a small sample of environmental educators and it is difficult to draw specific conclusions on how these indicators are linked to each other, and which weigh the heavier.

5.3.2 Unexpected findings

The indicators that were most likely to be found in the interview results were discussed in paragraph 2.4.2. Language and the effect of authorities were mentioned in the literature (Cothern 1996:43; Asia Food Information Centre and International Services for Acquisition of Agri-biotech Applications 2001:9), but the prominence given to these aspects in the interviews was unexpected.

Language

The terminology used in GM crops and modern biotechnology in general does not exist in most indigenous languages. Biotechnology has that evolved within Western modernisation and within those language structures. There are no words or terms in the southern African indigenous languages to allow communication about GM crops. The concepts themselves are difficult to understand for English language speakers. This poses a major challenge to any programme that wishes to focus on education in rural communities. More time, effort and discussion need to be allowed for appropriate language and terminology to evolve.

Cothern (1996:43) states that language can play an important role in erecting a barrier in risk perception. In the GM crops controversy environmental educators deal with different views of understanding: a scientific understanding and socially constructed understanding. Besides this, the concepts of modern genetic technologies, in this case GM crops, do not exist in indigenous language systems. Moreover, there is a great amount of technical jargon that the lay person needs to try to grasp in order to understand GM crops. At this critical point Corfield's (2003) suggestion that scientists should think beyond the minutiae of their research and the media need to think beyond 'breakthrough' is apt. The media and education have to find common ground between scientists and the public, which would require the development of a new vocabulary.

Environmental educators can play an important role in stimulating debate and participation based on the principles of education for sustainable development. In the

process they can help to develop a common language since the field requires at present technical jargon difficult for the lay person to understand. The end result would hopefully be a more understandable vocabulary to explain the terms and concepts in GM crops to rural people. Moreover, learners within the formal education sector will grow in their understanding of these concepts and terms as GM crop issues will be addressed in the formal curricula.

Emphasis on authorities and rational frameworks

The environmental educators interviewed seem to place considerable confidence in international organisations such as the UN to regulate issues like GM crops. There is a general expectation that these organisations would provide the guidelines and funding to initiate activities surrounding controversial issues like GM crops, as attempts are made to reduce poverty and food insecurity. A similar perception was observed in Japan (Chen Ng 2000: 112). However, it is strongly perceived that local authorities are not fulfilling their responsibility towards civil society to present balanced information. An economic bias, driving development in developing countries, forces authorities to favour a pro-GM standpoint. Environmental educators can play a significant role in awareness/education/capacity building programmes and projects. They often deal directly with decision makers or are in partnerships with them.

5.4 Answering the sub questions

This study aimed to answer the sub questions which were set out in Chapter 3, paragraph 3.2. The data obtained from the interviews was used to answer these sub questions. Once these questions were addressed, the main research question could be answered and possible implications for environmental educational processes and programmes are suggested.

5.4.1 What do environmental educators know about GM crops?

Chapter 4 paragraph 4.2.2 highlighted what the environmental educators interviewed understand about the concept 'GM crops'. Most environmental educators did not give an accurate scientific definition of 'GM crops'. Explanations were socially constructed based on a wide range of knowledge.

The lack of knowledge is seen as a key obstacle in the advancement of GM crops in the developing world. Joubert (2003:5) made a very strong statement in the PUB Business Plan that the current lack of understanding of this technology (including GM crops) is providing a vacuum for unbalanced and often, non-factual information to be disseminated and this has led to public confusion. She further emphasised the need for credible, factual, balanced and relevant information to be disseminated to the general public. The lack of balanced 'scientific' information is seen as the greatest danger (Joubert 2001).

While the environmental educators interviewed lack depth in their 'scientific' understanding of the concept GM crops, they generally gave adequate explanations. Their understanding seems to be more socially constructed. Most environmental educators work with environmental issues in a social, economical and political context. Such a multidisciplinary approach to issues, and issues like GM crops, would explain why their understanding of GM crops is more socially constructed. In this regards an interviewee questioned whether scientific or social knowledge was the most reliable.

The range of knowledge described here as socially constructed knowledge as opposed to scientific knowledge, is termed 'lay expertise' by Kerr, Cunningham-Burley and Amos (1998:52). Kerr et al (1998:52) further explain that social actors (like environmental educators) and institutions develop a unique set of knowledge from which they judge new experiences. Knowledge and understanding of the social world allow lay people to discuss new genetics, including GM crops, in a sophisticated and reflexive manner. The mobilisation of socially constructed knowledge is not straightforward because it is influenced by the perception of relevancy, social opportunity and power relationships (Kerr et al 1998:52).

Several studies (Millstone & Van Zwanenberg 2003:658; Toke 2004:185; Scott 2001:136) revealed the need for scientists to avoid a narrow-minded approach to complex issues like GM crops. Policy-making requires input of social knowledge from society. Public communication of science needs to translate technical jargon into a form of knowledge that can be understood by the general public including many in southern Africa, especially adults, who lack basic education. There is a great need for social input on complex issues like GM crops.

The environmental educators interviewed, with a greater social understanding of GM crops, have an important role to play in the public debate and the search for common ground in this debate. They can serve as channels of the social ethical understanding of GM crops to decision and policymakers. This will be particularly relevant in southern Africa where the GM debate is only beginning to receive attention.

5.4.2 What is environmental educators' opinion on the use of GM crops towards sustainable development?

The GM crop debate is as controversial as the sustainable development debate. However, the environmental educators interviewed seem to have a deeper understanding of SD than of GM crops. Several environmental educators are of the opinion that GM crops can play an important role in supplying food security and hence alleviating poverty in southern Africa.

Environmental educators interviewed emphasised the concern that SD is value laden. It is perceived that GM crops are promoted by a strong economic bias. Educators are of the opinion that environmental and social ethics are neglected in poverty relief and food security issues related to GM crops. Environmental educators can play an important role in the GM debate because of their multidisciplinary approach to issues in educational programmes.

5.4.3 How do environmental educators view GM crops in relation to other biotechnologies?

The questions asked in the interviews showed that environmental educators interviewed do not have a clear understanding of the relationship between GM crops and biotechnology in general. No specific question was asked about this relationship and answers from questions did not reveal an understanding of biotechnology. Paragraph 5.3.1 discussed this limitation.

Hoban (2004) from the FAO showed that studies on public attitude towards agricultural biotechnology had only been conducted in South Africa and Nigeria. Little information is available about public understanding of biotechnology elsewhere in southern Africa. Consequently little or in some cases no information about GM crops is available in certain southern African countries.

5.4.4 Do environmental educators view GM crops as a pressing issue in sustainable development?

Environmental educators interviewed are of the opinion that GM crops are a pressing issue. They believe that GM crops will need to be dealt with in this decade particularly in an African context. Several reasons were suggested as to why GM crops are such a serious issue, particularly relating to food security. These were:

- Questions about availability of seeds and quality of seeds
- Access to indigenous crops
- Value of indigenous crops
- Options available to the farmer
- Where seed can be bought
- Persistent droughts in southern Africa
- Many people on the brink of starvation
- The dependence on humanitarian aid

GM crops are perceived as a serious issue because they present a solution to food insecurity and poverty but also pose a risk. Therefore there is a need for caution. Some governments take GM crops seriously because they are attending meetings about biosafety where issues related to GM crops are discussed and action plans devised.

5.4.5 How do environmental educators' perceptions compare to other public perception surveys?

Previous perception studies that have been used to obtain indicators of perception on GM crops/foods have been all related to the general public. Joubert (2003:7) expressed the need for the PUB to better understand the perceptions of their partners and key audiences. Environmental educators can be strategic partners, although the nature of their work does not relate directly to GM crops in most cases. They are involved in environmental issues of an interdisciplinary nature. In most cases they obtained their information in the same way as the general public, except for a few that have a special interest and inform themselves via specialist sources.

Public perception studies on GM crops and foods have therefore been used to compare the perceptions of environmental educators. However, it would be more relevant to use studies conducted in southern Africa. Only a few studies have been conducted in Africa, i.e. in South Africa (Joubert 2001; Cole 2003; Kempen et al 2003; Webster 2001) and Nigeria (Hoban 2004). These public perception studies as well as studies conducted elsewhere in the world have been used to compare the perceptions of environmental educators. The results are expressed in table 2.1 and table 5.1.

5.5 Perceptions of environmental educators of GM crops

It can be concluded that environmental educators interviewed perceive GM crops as a serious issue in the progress towards sustainable development. It is thus an issue that needs to be addressed in environmental education programmes and projects. GM crops are of particular importance in the southern African context and in this decade - the Decade of Education for Sustainable Development.

The issues that environmental educators are involved in are complex and require a multidisciplinary approach. Environmental issues cut across several disciplines and require environmental educators to show an understanding from an economic, social, political and biophysical perspective. Such insight would be essential to grasp complex issues like GM crops.

The perceptions of environmental educators interviewed are socially constructed which is in turn determined by several indicators: knowledge; information sources; beliefs, culture and values; language; risk-benefit play off; trust; knowledge systems and uncertainty. These indicators are interlinked and affect one another. The socially constructed perceptions are valuable as a source of information for public debates and a greater understanding of the public perceptions. These socially constructed perceptions can be described as a scientific ethic (Cohen 1997:114), which refers to an elementary understanding of scientific principles but maintains a deferential respect for this knowledge system and its professional practitioners.

Environmental educators have a role to fulfil as mediators between scientists and the public, engaging both in participatory and critically reflexive processes. Such processes can lead to the development of a 'new' language which both groups understand, while

transferring useful information and building the capacity of the public to make informed decisions and participate more fully in policy formation regarding GM crops.

5.6 Implications of environmental educators' perceptions

Education is generally seen as the means to bring about sustainable development. The need for participation, awareness, education, capacity building and training is expressed in the goals of programmes like PUB. Lotz-Sisitka (2004:54) expressed concern that there is a poor understanding of the relationship between the concepts education, capacity building, training, participation and awareness in key international guiding frameworks such as the WSSD Implementation Plan, NEPAD and MDG. As a result the role of education in achieving the goals of these action plans is poorly articulated. There is a need for clear articulation of these concepts before they could be engaged in any programme. Programmes like PUB must also define the sphere in which they operate.

For the past 22 years EEASA has been concerned with education processes at a multidisciplinary level in southern Africa (EEASA 2001:1). Environmental education has developed open processes to deal with complex environmental issues. EEASA supports the open processes of teaching and learning in diverse contexts (Lotz-Sisitka 2004:52).

These processes are characterised by:

- A responsiveness which allows for participation and deliberation
- Participation which involves sharing experiences, criticality, and bringing of new knowledge
- Practical and reflexive application of knowledge in diverse contexts
- Critical and evaluative processes which foster meaning-making and criticality.

These processes can serve as channels to enhance public participation, communication, involvement and education about GM crops. Consequently, it is foremost to recognise environmental educators as social scientists. Although they do not necessarily have expert scientific knowledge about GM crops, their socially constructed knowledge is invaluable in dealing with a complex and controversial issue as GM crops. Scientists involved in public understanding of biotechnology need to recognise environmental educators as partners in their public programmes. This underlines a principle of partnerships in education for sustainable development.

There is also a need for partnerships between companies marketing GM crops in developing countries and social actors who specialise in dissemination of information, education and training, as stressed by the Nuffield Council on Bioethics (2004:76). This can ensure that more balanced information on the use of GM crops be shared with governments and people at all levels of society.

Education programmes cannot function in isolation but have to be constructed in such a way that the basic needs of people are addressed in the process. The importance of needs assessment is fundamental as the needs in various sectors of the population differ vastly. People in a rural area may be more concerned about whether they can replant the seed they received from food aid, whereas in an urban area labeling of food products and consumer choice is a higher priority. The implication is that an educational programme cannot function in isolation, but should work in conjunction with other programmes, for example food aid or community based natural resource management projects.

Dealing with the poor, and not just issues about poor people, is the challenge in southern Africa. Any process aiming to increase food security and alleviate poverty must have the empowerment of the poor at its core. The World Bank (2002b:18) stresses four element of successful empowerment of the poor:

- Access to information
- Inclusion and participation
- Accountability
- Local organisational ability

The necessity for an open debate about issues like GM crops is well recognised. Engaging people in a debate about GM crops will require an involvement from both the formal and non-formal educational spheres.

Formal education in South Africa has already identified the need to address issues like GM crops in the new Further Education and Training (FET) Life Science Curriculum (Department of Education 2003:35). However, there is a great need to supply under resourced schools with materials and equip teachers to use these materials. It is also important that these materials develop critical thinking and reflexive skills. Mayer and

Fortner (1987: 25) suggest that short intensive workshops are the most cost-effective way of ensuring proper usage of curriculum materials.

The non-formal education sector presents a greater challenge. Firstly, basic education of adults is a major need. The complex terms involved in GM crops do not exist in the indigenous languages in southern Africa. There is a need for an open, reflexive and participatory process that will engage and empower people. The characteristics of open processes and elements of empowerment have been mentioned earlier in this paragraph. They can play a significant role in greater public participation and education, benefiting programmes like PUB.

5.7 Recommendations for future research

This study has provided a rich source of information but has shown some limitations. A more detailed follow-up study of the perceptions of environmental educators, as well as other groups will be useful. Such studies can use the information from table 2.1 as the basis to construct questionnaires. A study using a questionnaire and individual or focus group interviews can be very useful. Biographical information can be obtained using a questionnaire and open-ended questions can be used to gain an understanding of the other indicators of perception. Questions focusing on the belief, culture and values of a specific group and the risk/benefit perception can be very useful to scientists, education specialists and programme and project developers.

Developing an empirical scale that measures perceptions of perceived risk about GM crops can have many applications. Such a scale will have to measure more than knowledge as people tend to act on their perceptions regardless of whether they are accurate (Weber et al 2000:28). Such a scale will be beneficial to assess the effectiveness of educational programmes.

The most important recommendation is to translate these perception studies effectively into educational programmes. Lotz-Sisitka (2004:38) raised such a question, when dealing with the GM crops issue:

What role could environmental educational processes play in enabling greater reflexivity and participation in response to the environmental issues and risks (posed by GM crops)?

Subsequent studies could focus on a process in both formal and non-formal education to ensure greater reflexivity and participation in response to the GM crop controversy. Evaluation of the open processes referred to by Lotz-Sisitka (2004:51) on the GM crops issue in southern Africa could prove valuable.

5.8 Conclusion

Environmental education is not only concerned with global issues like pollution, global warming and biodiversity loss but also with current and modern developments like GM crops and biotechnology. The notion of sustainable development has placed social issues on the agenda of both developers and environmental activists. Lotz-Sisitka (2004:57) summarises the role of environmental education should play in the future:

Environmental education processes in southern Africa have a key role to play in both investing in human development and in protecting environments to ensure sustainable livelihoods and safe environments for all.

The greatest contribution that this study makes to the field of environmental education is that it raises awareness amongst professionals and interest groups of a controversial and contentious issue – GM crops. GM crops have provoked heated debates all over the world and recently have become an issue in southern Africa. This has been caused by the desperate need for food and seed aid in areas where millions are on the brink of starvation. As a result the context of the GM crops debate in southern Africa is different from that of the Western and developed world. This provides an opportunity for Africa to determine its own destiny regarding the GM crops issue (Priest 2003).

GM crops is a complex issue where a great deal of uncertainty still exists about the risks and benefits. The question as to how GM crops are perceived by environmental educators regarding their use towards sustainable development formed the crux of this study. Establishing an answer to this question lays a foundation to prepare environmental educators to be more pro-active.

Environmental educators, who deal with issues on a multidisciplinary level, perceive GM crops as a serious issue. Their perceptions of GM crops are more socially constructed, and they can thus make valuable contributions at grassroots level where the GM debate takes place. The finding that environmental educators' perceptions of GM crops

constitutes more than cognitive factors ('scientific' knowledge and opinion) can allow them to engage more fully in this contentious issue, stimulating greater participation, reflexivity and criticality, involving all sectors of society.

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Appendix A – Interview Questions

The questions that were used in the interview are listed below:

1. Which organisation/company do you work for?
2. What is the nature of your work?
3. **What do you understand by the term genetically modified (GM) crops?**
 - What do you think is the link between GM crops and modern biotechnology?
 - Does the quality of your work depend on your knowledge of GM crops or biotechnology?
4. **What has been your main source of information about GM crops?**
 - Who do you think presents more reliable information on GM crops?
5. **What do you think is meant by sustainable development?**
 - How high do GM crops come on your list of issues of concern with regards to sustainable development? Why?
 - Do you think that GM crops have any use in sustainable development? What?
 - Do you think that GM crops pose a threat to sustainable development? What?
6. **What do you feel about the authorities making decisions with regards to policies on GM crops?**