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RISK PERCEPTION, RISK COMMUNICATION, AND THE EFFECTIVENESS OF PESTICIDE LABELS IN COMMUNICATING HAZARDS TO SOUTH AFRICAN FARM WORKERS

Volume I

By

Hanna-Andrea Rother

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ABSTRACT

RISK PERCEPTION, RISK COMMUNICATION, AND THE EFFECTIVENESS OF PESTICIDE LABELS IN COMMUNICATING HAZARDS TO SOUTH AFRICAN FARM WORKERS

By

Hanna-Andrea Rother

More than 80 percent of global pesticide usage occurs in developed countries; despite this, 99 percent of all recorded pesticide poisoning cases occur in developing countries. Pesticide labels are a risk management strategy for communicating health risks to farm workers with the assumption that the transmission of this information in itself will evoke the required safety behaviors for farm workers to reduce poisoning incidents. Despite the use of pesticide labels, pesticide poisonings continue in developing countries.

This dissertation argues that pesticide labels are ineffective in communicating health and safety risks with the intention of evoking safety behaviors. This hypothesis was couched in the environmental sociology literature of risk perception (i.e., the psychometric model, the Cognitive Social Psychological Model, the Health Belief Model, and Cultural Theory) and risk communication (i.e., the social amplification model and the mental model approach). In reviewing pesticide labels ineffectiveness as a risk communication tool, this research attempted to assess (1) whether there is an interaction between farm workers' pesticide risk perceptions and pesticide risk communication and (2) if this interaction influences the effectiveness of risk communication tools, along with pesticide risk decision-making.

Face-to-face interviews and focus groups were conducted with 115 farm workers on wine and table grape farms in the Western Cape of South Africa. Statistical and ethnographic findings measure farm workers' pesticide risk perceptions and their social/cultural interpretations of the label components, including pictograms, color codes, and precautionary statements. A factor analysis identified risk perception and risk communication factors that highlight the interaction occurring between the two.

The dissertation results show that South African farm workers' pesticide risk perceptions are high. Findings further indicate that approximately 50 percent or more of the farm workers had misleading, incorrect and critically confused interpretations of the pesticide label components. Perceptions and label ineffectiveness were further highlighted by various influencing factors identified such as "authority influences" (e.g., by farm owner, pesticide company representatives), social framing effects (e.g., Apartheid legacy, farm worker's subservient relationship with farmer), gender influences (e.g., women not receiving pesticide training as women's work is not believed to lead to pesticide exposures although they mix pesticides and work in sprayed fields), and industry's "safe-use" training programs (e.g., claiming intrinsically that all pesticides are safe). Another study finding was that five pairs of risk perception (RP) and risk communication (RC) factors significantly reinforce the interaction between each other. These factors of interaction identified were eternalized risk (RP) with familiarity (RC), externalized risk (RP) with emic view (RC), relative risk (RP) with etic view (RC) and tangible risk (RP) with emic view (RC). Environmental sociologists should challenge traditional risk perception and risk communication research approaches by incorporating this interaction element into future research, especially in developing countries.

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CHAPTER ONE

INTRODUCTION

1.1. FARM WORKERS AND PESTICIDE LABEL USE IN SOUTH AFRICA AS A CASE EXAMPLE – RESEARCH RATIONALE AND QUESTIONS

1.1.1. Technological Risk Management

Farm workers in all regions of the world are exposed to pesticides, repeatedly and often, over the many years they work. Although more than 80 percent of pesticides used are applied in the developed countries, 99 percent of all recorded pesticide poisoning cases occur in the developing countries (FAO Newsroom Archives 2002). The World Health Organization (WHO) has estimated that 25 million agricultural workers in developing countries alone experience one or more incidents of acute pesticide poisoning annually (Jeyaratnam 1990).

These incidents continue despite various attempts to reduce pesticide poisonings, often through protection mechanisms that are legislated both nationally and internationally. On this basis and more specifically, I argue that technological risk management strategies, such as risk communication tools, fail to protect farm workers from pesticide exposures. Technological risk management strategies are often "imported" from developed to developing countries based on the assumptions that (1) organizations (industry, government agencies, and research institutes) in the developed countries possess all the "expertise" necessary to understand all the avenues of potential risk, and (2) it is a simple technical task to communicate this risk to workers in developing countries in a way that elicits the desired protective behaviors. One example of a transferred risk communication tool commonly seen around the world is the labels

used on pesticide containers. Pesticide labels are the vehicle used by industry and the state to communicate to the end-user risk and hazard information about pesticides.

According to Gerrad et al., "a fundamental assumption underlying efforts to communicate accurate risk information to the public is that individuals will be more capable of making important decisions about precautionary and risk behaviors if they are more knowledgeable about the consequences of those behaviors" (1999: 94). A concomitant assumption is that risk communication tools can be effective in altering risk perceptions and this in turn will motivate people to embark on effective and appropriate precautionary behavior. In contrast to these assumptions, however, in this dissertation, it is argued that (1) without training, risk communication tools have limited cross-cultural effectiveness in promoting safety behavior, and (2) even training neither guarantees the intended comprehension nor ensures an appropriate safety behavior. It is also argued that an explanation for these failures of protection is that risk communication devices are not universal tools which function in isolation from the social and cultural context in which they are used. Instead, an interaction takes place between risk communication tools, such as pesticide labels, and perceptions of a particular risk, such as familiarity with pesticides. It is argued that this interaction between risk communication and risk perception influences behavior -- specifically in this case, safety behavior aimed at reducing potential adverse health effects associated with pesticide exposure (see Figure 1). Thus, this dissertation focuses on the interaction of pesticide risk communication, pesticide risk perception, and risk communication processing as they jointly affect pesticide risk decision-making.

1.1.2. Research Focus – Farm Workers and Agricultural Uses of Pesticides

Pesticides are used extensively and intensively in South Africa for both agricultural and non-agricultural purposes (Rother and London 1998). South Africa also manufactures and formulates pesticides locally and exports these to the southern African region (Dinham 1993). This dissertation focuses on agricultural uses of pesticides as a case example, paying particular attention to the use of pesticides in fruit and wine grape production in the Western Cape of South Africa. Not only is pesticide use intensive and extensive in fruit and wine grape production, but Western Cape farming has a historical legacy in which farm workers are an integral component of the production system (Lipton et al. 1996a). Farm workers were previously viewed by farm owners as a controllable factor of production, and a dependency relationship was created and encouraged because the farm owner was both employer and landlord. Farm owners today still have an immense influence on the day-to-day decisions of the farm worker community, and there is little distinction between farm workers' conduct on and off the job. This relationship between farm owner and farm worker is a particular trait of Western Cape agriculture. As Lipton et al. state, "the legal and social condition of slavery left an indelible mark on agricultural labour relations, and still informs many of the social practices in the Western Cape" (1996a: 355). Until recently, farm workers lived in sub-standard housing and sanitation conditions (often with no electricity and no running water) on the farm where they worked, and were paid low wages with part of their wages sometimes replaced with cheap wine (the tot system[1], see Chapter Four for a

[1] More commonly referred to in Afrikaans as the *dop* system which developed at the end of the nineteenth century when a severe recession rendered once profitable farms into uneconomic units (Scully 1987). Looking for means to cut labor costs, cash-strapped farmers turned to the abundant supply of cheap wine to pay laborers, institutionalizing the *dop* system. According to Lipton et al., "in order to ensure a docile

further discussion). Although the plight of farm workers is improving in post-Apartheid South Africa, farm workers continue to be predominately dependent on farm owners for health and safety information and for protection from exposure to pesticides.

The social, legal, political, cultural, economic and historical context within which farm workers' work and live places them at particular risk from exposure to pesticides. Farm workers' social context includes unhealthy and crowded living conditions, intense alcohol use and high rates of alcoholism[2], malnourishment, and many suffer from diseases such as TB. While South Africa has a progressive and relatively contemporary structure of pesticide regulation (Rother and London 1998), the legal context for farm workers is such that pesticide mortality and morbidity continues unabated (London 1995a). Farm workers exist in a political context where there is a lack of political support and priority setting of pesticide issues with the result of, for example, limited enforcement of an otherwise good regulatory structure. Risk information is available on pesticide labels for farm workers in a cultural context where there is a lack of a label using culture and coupled with a culture of high pesticide use. The Western Cape Province of South Africa is a major producer and exporter of commercial fruit and wine grape production where the use of pesticides is high in this economic context. The historical legacy of slavery and Apartheid places farm workers in a vulnerable position of living and working on commercial agricultural farms where they are exposed to pesticides both directly and indirectly with limited, if any, protection.

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work force, employers distributed as much as six pints of wine to each worker on a daily basis" (1996a: 356).

[2] Alcoholism became the single largest social problem on Western Cape farms with generations of farm workers growing up under the *dop* system (Lipton et al. 1996a).

International pressure on the exporting sector of Western Cape agriculture, through the Euro Retailer Produce Working Group's Good Agricultural Practice standards (EUREPGAP 2000), is requiring improved working and living conditions for farm workers, including increased training about pesticides, in order to receive certification for importation into western Europe. Thus farm workers are now more exposed to information on pesticides than in previous years. This leads us to ask: What are farm workers' current perceptions of the risks associated with pesticides? Are farm workers able to use risk communication tools, such as pesticide labels, to choose and implement appropriate safety behaviors? This dissertation addresses these, amongst other, questions.

1.1.3. Research Focus – Pesticide Labels

Pesticide labels are a risk communication tool designed by the chemical industry as a means to present hazard information about a particular pesticide to the end-user. The hazard information and technical expressions of this information are developed by the parent companies in the North. Thus when a pesticide is exported, the label information is also exported. South Africa formulates most pesticides used in the country and produces the labels with the local company details and sometimes puts the information into Afrikaans (a South African language). However, the actual technical hazard information comes from the parent company.

For South African farm workers, the pesticide label is often the only means to obtain safety, health, hazard and first aid information about particular pesticides. In South Africa, the pesticide label is not only a risk communication tool, but also a legally binding document (Rother and London 1998). That is, end-users can be penalized for

misuse should the pesticide be used in any way other than in accordance with the requirements stipulated on the label. This responsibility for proper use is legally binding regardless of literacy, ability to read the label language, or comprehension aptitude. From a sociological perspective, the label provides an apt unit of analysis for assessing risk communication effectiveness, the role of risk perceptions, and issues of comprehensibility. Thus, this research contextualizes the use of pesticide labels in the Western Cape Province of South Africa by researching and analyzing farm workers' pesticide risk perceptions and label comprehension abilities.

1.1.4. Research Proposition, Questions and Hypothesis

The basic proposition of this research is that pesticide risk perceptions and label comprehension abilities are the two major determinants of the risk communication effectiveness of pesticide labels. More specifically, this research attempted to assess (1) whether there is an interaction between farm workers' pesticide risk perceptions and pesticide risk communication, and (2) if this interaction influences the effectiveness of risk communication tools. In this research, effectiveness was assessed through comprehension of intended meanings and not specific behavioral outcomes.

Although the social analysis of risk has progressively become for social scientists a dominant organizing theme for the analysis of contemporary society, more research is needed (especially from developing world contexts) on the interaction between risk perception and risk communication in influencing risk management and risk decision-making, and thus ultimately affecting risk behavior. More research is required as existing literature presents risk communication as an effective means for changing risk perceptions through the provision of risk information with the intention of provoking

behavioral changes, especially in relation to human health (Gerrad et al. 1999). However, the risk literature does not consider how risk perceptions influence the way in which risk information (i.e., risk communication tools) is interpreted. A hope is that through the documentation and understanding of South African farm workers' pesticide risk perceptions and comprehension of the pesticide label components, risk communication tools, and the use of these tools, can play a more effective role in raising awareness of risks within different cultural and social contexts. For farm workers in South Africa, who are largely dependent upon farm owners and managers for information, the pesticide label potentially is a source of vital risk information otherwise not provided to them. As for the general population in South Africa, the pesticide label is often the only source of risk information. In light of the important role the pesticide label plays as a risk communication tool in South Africa (and elsewhere in the world), the key questions in this dissertation are:

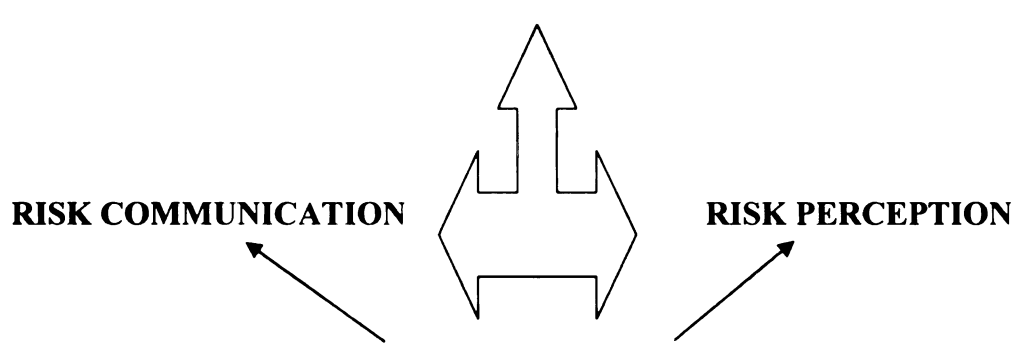
- How do people's risk perceptions affect risk communication?
- How does risk communication affect risk perception?

For example: What are the factors influencing the effectiveness or non-effectiveness of hazard communication tools? Do risk perceptions influence the effectiveness of hazard communication tools? Are there inherent assumptions behind hazard communication tools that are inaccurate when applied to real life contexts?

In relation to these research questions, the hypothesis is that the interaction between risk communication and risk perception affects behavior (see Figure 1). Consequently, risk management strategies employing risk communication measures to alter risk perceptions will be limited in their effectiveness if the role and influence of risk

perceptions on the interpretations of risk communication tools is not taken into account. Thus an analysis of this interaction provides insight into the components influencing this interaction in order that risk management strategies are able to assess potential behavioral outcomes.

Figure 1: Interaction Between Risk Communication and Risk Perception



Background influences:

⇒ Context (culture, policy, history, economy, law)
⇒ Gender
⇒ Training
⇒ Knowledge about pesticides
⇒ Literacy
⇒ Exposure to a previous poisoning incident
⇒ Formal education

The backdrop against which this interaction between risk communication and risk perception is being played out is the historical context of culture, social factors, economics, politics and legal issues of a society. Thus the research findings of this dissertation are situated within this contextual backdrop (see Chapter Two).

1.2. RISK

Understanding how people interpret, and react to, risks becomes important, especially for understanding risk-related behavior, communicating risks, and developing

policies concerning risky technologies, as well as promoting protective behavior. Both as an analytic and as a normative endeavor, risk research provides a platform for understanding and potentially reducing unwelcome or undesirable consequences. Social institutions (e.g., agencies, social groups within society, individuals) determine the acceptability of a given risk and manage the risk accordingly. The concept of "risk management" involves the processes of reducing risks to what society deems acceptable, controlling risks at these levels, monitoring risks, and communicating about these risks (Zimmerman 1986).

1.2.1. Defining Risk

In order to study the interaction between risk communication and risk perception, an understanding of the meaning of "risk" is required. Risk is increasingly being used by social scientists (e.g., environmental sociologists, ecological anthropologists) as a dominant organizing theme for the analysis of contemporary society, both in developed countries (Beck 1992) and in developing countries (Adam 2000). In this dissertation, risk is defined as the possibility that human actions will result in consequences that harm humans and/or "things" humans' value (Klinke and Renn 2002; Kates and Kasperson 1983; Hohenemser, Kates, and Slovic 1983). Risk analysis (North 1995) is seen as consisting of risk identification (Krewski and Birkwood 1987), risk assessment (exposure and dose-response relationships; Haimes 1998), risk characterization (National Research Council 1996), risk management (Haimes 1998), and risk communication (Morgan et al. 2002). However these five components of risk analysis are interrelated. For example, risk communication is usually executed as part of risk management following on from

risk assessment, with the intention of influencing and controlling risk perceptions (Gerrad et al. 1999; Risk World 1997).

1.2.2. Risk Characterization

The characterization of a particular risk includes the perceptions of that risk held by members of different groups in the risk situation. Risks associated with exposure to hazards from particular technologies (e.g., nuclear energy, pollution, chemicals) are often presented as dichotomies between the "actual" risks (as properties of the technologies) as assessed by the "experts" (e.g., biophysical scientists), versus the "perceived" risks of exposure to the technologies as understood by the lay public. The assumptions of this view are that "experts" grasp the real, objective risks and that the public can only comprehend perceived subjective risks (Shrader-Frechette 1990[3]). Although it is beyond the scope of this dissertation to develop a full discussion of the dichotomization of "real" versus "perceived" risk or realism versus social constructivism (cf. Shrader-Frechette 1990, Bradbury 1989, Clarke and Short 1993), this work begins from the premise that it is perceived risk that influences risk decision making and thus risk management behavior; thus this work focuses on the cognitive and organizational processing of risk both in the formation of risk perceptions (i.e., by farm workers in South Africa exposed to pesticides) and in the development of risk communications (i.e., the composition of pesticide labels).

[3] For a more detailed discussion on perceived risks versus actual risks, see Shrader-Frechette KS (1990) *Perceived Risks Versus Actual Risks: Managing Hazards Through Negotiation.* http://www.fplc.edu/RISK/vol1/fall/shraderF.htm.

1.2.3. Social Construction of Risk

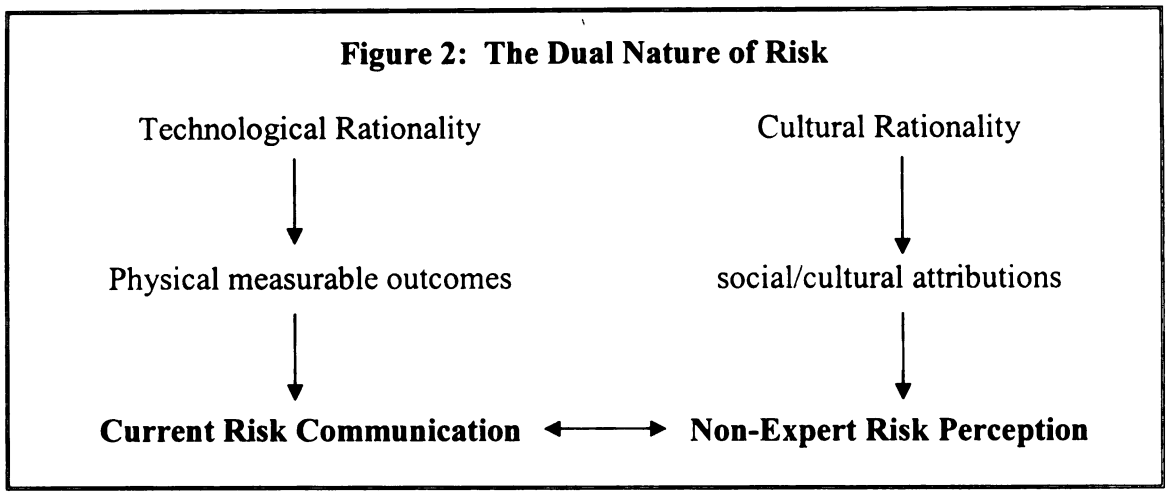
Risk perceptions, in one sense, are viewed as individuals' personal considerations and private understandings, and in another sense as the result of a continuous process of communication and interaction among members of a social structure. This process of communication and interaction includes both informal (e.g., friendship, kinship) and formal (e.g., governance, workplace, commercial) networks, where communication and discussions with others function to confirm and verify positions already held, as well as to encourage revisions of these norms, attitudes, beliefs and practices (MacGill 1988). As risks (e.g., technological risks) exist in and through the social fabric, it has been argued that risks are not simply objective conditions "out there" waiting to be perceived by individuals, but instead risks are claimed to be a social construct (Dake 1992).

According to Adam et al. (2000: 2), the importance of risk is not that "it *is* happening, but that it *might* happen." As Beck argues, "ultimately...it is cultural perception and definition that constitutes risk" (Adams et al. 2000: 213). Risk is shaped by different interests in society and the social construction of risk implies that social elements function to produce technological risk perceptions. That is, in order to comprehend an individual's risk perception there is a need to understand the social context within which risk perceptions are formulated and the processes of this social construction. Furthermore, in comprehending why different people have varying risk perceptions, there is a need to understand how the social construction processes vary between individuals within a cultural group within society and cross-culturally across societies. Thus one needs to ask, if risk is a social construct, what are the influences on the social construction of risk? How do these influences affect the communication of risk? How does the process of communicating risk influence the construction of risk?

1.2.4. The Dual Nature of Risk and Risk Analysis

Short (1989) and Rosa (1998) argue that the definition of risk must not be limited to perceptions and social constructions alone, nor reduced to only objective outcomes (e.g., injuries, fatalities or other types of losses). Instead, risk needs to incorporate both the "cultural attributions" and the "physically measurable outcomes" which together form the content of what is termed "risk" (Klinke and Renn 2002). "How people select issues of concern and how they model likelihood may indeed be a result of cultural conventions and rules" (Ibid, 1076). Klinke and Renn (2002) argue that this dual nature of risk requires a dual strategy in risk management. Thus, this dissertation highlights the interaction between these dual elements comprising risk -- the physical measurable outcomes ("technological rationality") expressed in most current risk communication strategies, and the social/cultural attributions ("cultural rationality") manifested through non-expert risk perceptions (see Figure 2). For more effective and efficient management of pesticide risk and for better understanding of risk decisions, the interrelationship between these two components of risk needs to be more clearly comprehended.

There is an increasing body of literature demonstrating that risk decisions are multidimensional and embrace this dual nature of risk by incorporating both the technical and social understandings of risk (Hamilton 2003; Plough and Krimsky 1987; Cvetkovich and Earle 1992; Fiorino 1989; Kasperson et al. 1988; Renn 1992; Vaughan 1995). Plough and Krimsky (1987) have provided a foundation for discussions about risk by their work on these competing rationalities for interpreting risk -- "technical rationality" and "cultural rationality". These concepts encompass what vast amounts of risk literature describe as the "expert" and "lay" views of risk, and the values, ideologies and goals for risk management inherent in each of these views (Hamilton 2003).



"Technological rationality" refers to understanding risk as guided by values of science, for example quantification, objectification, and comparison across cases through methodological approaches such as risk assessments (Hamilton 2003; Plough and Krimsky 1987). In contrast, "cultural rationality" focuses on understanding risk through experience, analogy, historical precedent, and democratic processes for decision making; this approach emphasizes the social and political context of the risk as paramount in the analysis of risk (Hamilton 2003; Plough and Krimsky 1987). This dual nature of risk is represented in this dissertation through an analysis of technical rationality expressed through pesticide labels and an analysis of cultural rationality represented in South African farm workers' pesticide risk perceptions.

1.3. ORGANIZATION AND STRUCTURE OF THE DISSERTATION

1.3.1. Research Orientation

In order to increase the understanding of the dual nature of risk, and more specifically of the interaction between risk perception and risk communication, this research conducted a survey of farm workers in the Western Cape of South Africa. The

survey was designed to assess the risks perceptions concerning pesticides, and the comprehension of risk communications about pesticides, of the farm workers.

1.3.2. Dissertation Structure

As previously noted, an analysis of the interaction between risk perception and risk communication needs to be placed within the historical context of culture, social factors, economics, politics and law. To this end, Chapter Two paints the background picture of the use, regulatory structure, and health effects of pesticides in South Africa, as well as discusses contextual factors influencing the effectiveness of pesticide protection mechanisms. The role of the agricultural industry is highlighted and the intensity of pesticide use in South Africa presented. This chapter presents the pesticide label as an apt case for analyzing the relationship between risk communication and risk perception, and the influence of this relationship on safety behavior. The chapter concludes with questions to be addressed in the dissertation about the viability of pesticide labels as a hazard communication tool.

This research is couched within the theoretical context of the risk perception literature and the applied context of the risk communication literature. In line with these two themes of this dissertation, risk perceptions and risk communication, Chapter Three presents the literature review in two sections. Within the field of risk perception, social scientists tend to agree that no one theory has managed to offer a full explanation of risk perceptions and the factors driving these perceptions. Therefore, this research relied on the theoretical and methodological underpinnings from four different approaches which are presented in the first part of Chapter Three. These four approaches and their short-falls presented are: the psychometric model, the Cognitive Social Psychological Model

(CSPM), the Health Belief Model (HBM), and Cultural Theory. This section also presents three main themes important in risk perception research and for the findings in this dissertation. These are: risk perception cross-culturally, multiple risk perspectives, and risk perception and gender.

The second half of Chapter Three presents the risk communication literature review which covers risk communication factors (i.e., audience, messenger, message, medium) and three schools of thought on how risk communication can control risk (i.e., risk communication as public relations, a business strategy and as risk management). This review focuses on risk communication as risk management, highlighting the social amplification model and the mental model approach to risk communication. The debate between the "expert" view (technical rationality) and the lay perspective (cultural rationality) in risk communication is also discussed. The third and last section of this chapter reviews where the risk perception and risk communication literature interact with one another and ends with the presentation of the dissertation research questions.

In Chapter Four, the methodological approaches used in this dissertation are discussed. In addition, background information is provided on the research site, the study population, the recruitment of interviewers and the survey design. A discussion of the process of data analysis used in this dissertation concludes this chapter.

Chapter Five presents the research findings on the pesticide risk perceptions of farm workers in the Western Cape. These statistical and ethnographic findings are presented under the rubrics of the content of perception of pesticide risks and the background influences of risk perceptions (e.g., gender, education, age, occupational role, previous experience). The chapter concludes with an in depth discussion of the

influences on South African farm workers' risk perceptions, particularly the social and cultural influences.

Chapter Six presents the statistical and ethnographic findings of farm workers' comprehension of the pesticide label components (e.g., color codes, pictograms, technical language). Along with an analysis of farm workers' interpretations of the label components is a discussion of the various problems with label comprehension that inhibit the intended result of appropriate safety behavior.

In Chapter Seven, the final findings of this dissertation are presented. A factor analysis approach was tested for reliability and used for understanding the interaction between risk communication and risk perception. The factors identified were constructed based on the variables identified in Chapter Five representing farm workers' pesticide risk perceptions and from Chapter Six representing comprehension of the pesticide label components for risk communication. Five factors for both risk perception and risk communication are identified and interpreted. This chapter concludes with a discussion of the interaction between these factors and the insights these shed on risk communication interacting with risk perception.

This final chapter concludes this dissertation by reflecting on the findings and results of this dissertation and what significance these have for theory and policy, as well as applicability to other research issues. This chapter finishes with recommendations for future research.

CHAPTER TWO

CONTEXTUALIZING THE SOCIAL CONSTRUCTION OF PESTICIDE RISK IN SOUTH AFRICA

2.1. INTRODUCTION

This chapter presents the cultural, social, economic, political, and legal dimensions of pesticide use in South Africa in a historical context. In order to understand the construction of pesticide risk in the South African situation in general, and for farm workers in particular, there is a need to understand this context and its implications for both the construction of pesticide risk perceptions and the use of pesticide risk communication tools.

I would like to begin the presentation of the context with a little personal background. From 1996 to 1998, I worked in collaboration with the then Department of Community Health at the University of Cape Town in South Africa on a South African Pesticide Policy Project. The objectives of this project were: 1) to describe the legal framework for pesticide safety; 2) to identify existing administrative structures and policy structures for pesticide safety; and 3) to review existing structures' contribution to key public health functions (e.g., training, disease and exposure surveillance, poisoning prevention, averting environmental contamination). During this project, personal interviews were conducted with key actors in the pesticide arena in South Africa, including representatives from:

- National Government:
  - Department of Agriculture (the Registrar of Pesticides and a technical adviser),
  - Department of Labor,

- Department of Health (the Environmental Health person assigned to pesticide notifications and pesticide awareness issues; members from the Food Quality Department involved in maximum residue setting),
- Department of Environmental Affairs and Tourism
- Department of Water Affairs
- Agricultural Research Council

➢ Non-Governmental Organizations:
- Poison Working Group of the Endangered Wildlife Trust
- Environmental Justice Networking Forum
- Earthlife Africa

➢ Industry Associations:
- AVCASA – the Crop Protection and Animal Health Association
- CAIA – the Chemical and Allied Industries' Association

➢ Researchers and other relevant individuals:
- Policy Unit at University of Witwatersrand
- Farming Cooperative working in Integrated Fruit Management
- Various individuals working on aspects of pesticide issues.

Conducting personal interviews, attending relevant meetings and reading pertinent documents (pesticide legislation, papers and publications written on pesticide issues in South Africa and elsewhere, technical documents) provided the insights and foundation for the contextual information in this dissertation. The insights and information expressed in this chapter and permeating this work were born from this research (see the resulting report from this project; Rother and London 1998).

2.2. PESTICIDE USE IN SOUTH AFRICA

Pesticides are used extensively in South Africa in agriculture, residential uses (both indoor and outdoor), public health uses (e.g., mosquito and tsetse fly control), public buildings, and public environments (e.g., parks, gardens, road verges), as well as for veterinary uses (Barlin-Brink 1991; Emanuel 1992; Dinham 1993; London and Myers 1995a&b; Rother and London 1998; London and Rother 1998). This broad-spectrum use

of pesticides exposes farmers, farm workers, pest control applicators, the general public, tourists and others to the hazards associated with pesticides without discriminating between groups with differing sensitivities to these hazards – women or men, elderly or adults or children, immune-compromised or healthy. Pesticides touch the total population in South Africa; however, this research project specifically focused on the implications of pesticide use for male and female farm workers in the South African agricultural sector. Although farm workers are exposed to both agricultural pesticides and residential pesticides, this dissertation focused on agricultural pesticides so that the research could explore farm workers' understandings of the pesticide labels found on agricultural pesticide packaging.

In the following section I briefly discuss the non-agricultural uses of pesticides by farm workers. I then return to the main focus on agricultural pesticides.

2.2.1. Farm Workers' Non-Agricultural Uses of Pesticides

Although this research focused on agricultural uses of pesticides, in the farm workers' context, pesticide exposure occurs both from agricultural and non-agricultural uses. Residential uses of pesticides include the use of household insect sprays for insects such as flies, cockroaches, and ants (e.g., *Doom*, *Target*, *Baygon*, *Fast Kill*[4]); garden pesticides; mosquito sprays, impregnated bed nets, coils and repellants (although used to a lesser extent in the Western Cape); rat poisons; and the spraying of beds or dipping of blankets for fleas and bedbugs. Farm workers purchase some household pesticides themselves, while others they receive from the farm owner or manager. The difference

[4] The active ingredients in these products vary from organophosphates to pyrethroids. *Doom*, one of the most commonly used household sprays, is an organophosphate and is classified in the second most toxic category.

between these two is important, because in the latter instance those pesticides would be commonly decanted into unmarked, unlabelled containers. In other South African research studies I have been involved in, cockroaches and bed bugs have been identified by farm workers as problematic and some farm owners bring in pest control companies to spray workers' houses (Rother, unpublished research 2003). Thus there is potential for high exposure to non-agricultural pesticides.

Farm workers, as well as others (e.g., farm owners, industry, government officials, and the general population), often regard domestically used pesticides as less toxic than the pesticides used in agriculture (Rother unpublished research 2002; Rother 2000; Rother and London 1998). This belief is reflected in the differences between the ways in which domestic/household pesticides are regulated compared to the ways in which agricultural pesticides are regulated. For example, domestic pesticides (e.g., household insecticide sprays such as *Doom*, *Baygon*, *Target* or *Fast Kill*) in the same toxicity category as an agricultural pesticide, will often not have the same warnings and pictograms on the label as the agricultural pesticide. Arguments for this have been that the labels on domestically used pesticides are smaller than those used in agriculture, that the concentrations vary, and that people would be put off using a product with a lot of danger or precautionary symbols on it (personal communication with Johan Vermeulen 2003, previous technical advisor to the South African National Department of Agriculture, presently consultant for Crop Life South Africa). At present, there is no legislation or regulation specifying what has to be on the label or describing the label layout, leaving room for great differences.

2.2.2. Significance of Agricultural Uses of Pesticides

The use of pesticides in South African agriculture continues to increase (Dinham 1993; Rother and London 1998; Naidoo and Buckley 2003). This is especially the case for small-scale and emerging farmers[5] in post-apartheid South Africa who are encouraged by government to compete with commercial farmers for export markets (Agricultural News 1997). Large scale commercial operations also predominately depend on intense spraying schemes, thus making pesticides a major component of farmers' total production costs (Dinham 1993).

Sales of crop protection products in South Africa (excluding exports) reached R1,600 billion (~US $230 million) in 2001 (Crop Protection and Animal Health Association 2001), compared to sales of R600 million (~US $86) in 1992 (Dinham 1993). Table 1 presents the distribution of expenditure on the various crop protection products, highlighting the high use of herbicides in South Africa. This is a significant issue that will be picked up again in Chapter Five, especially in terms of the influence the different types of pesticides (e.g., herbicides, insecticides, fungicides) have on farm workers' pesticide risk perceptions.

TABLE 1: Share Of Total Expenditure On Different Types Of Crop Protection Products In 2001 (%)

Herbicides	44
Insecticides	30
Fungicides	21
Other[6]	5

Source: Crop Protection and Animal Health Association (AVCASA) 2001

[5] "Emerging farmers" is a term commonly used in South Africa, but one that has no definitive meaning. However, from all my research and documentary review, it is my understanding that this term refers to black farmers who are not yet considered commercial farmers and still require support from the Department of Agriculture. The important point is that these farmers rely heavily on pesticides in order to obtain the commercial markets and often employ farm workers.

[6] This category includes plant-growth regulators, and industrial and amenity uses.

2.3. SOUTH AFRICAN AGRICULTURAL SECTOR

2.3.1. Context of South African Agriculture

The South African agricultural context influences farm workers' exposure to pesticides and to pesticide risk information. Although the practice of agriculture in South Africa was established some 2000 years ago when the early Bantu-speaking people introduced farming, commercial farming as it is known today was introduced by white settlers around 1657. Agriculture is deeply ingrained in the ethos of South Africa and across South African cultures, especially as South Africa was an agrarian state prior to World War II. According to Lipton et al., "South Africa's agrarian institutions were not the outcome of natural evolutionary adaptation...there was systematic political intervention in favour of large, white farmers against black small holders" (1996a: 404). Thus, within South Africa two agricultural sectors have predominated – the small scale black subsistence farms, and the large, capital intensive white owned farms (in 1990, 86 percent of land was reserved for whites, and their farms produced 90 percent of marketed production; Lipton et al. 1996a).

The previous South African state supported large, capital intensive white agriculture and agribusiness (e.g., pesticide companies) through an administrative and regulatory system exclusively for white agriculture and white run agro-industries. According to Lipton et al. (1996a), this was expressed through policies such as subsidized credit for white farmers, lowering of transaction costs for white farmers while increasing the transaction costs of black farmers, and building of an infrastructure supporting white farmers (e.g., Agricultural Department, statutory marketing boards,

Land Bank and Agricultural Credit Boards, numerous government funded training and research institutions).

Around 1970, white owned commercial farming operations shifted from mechanized farming towards more labor intensive farming, drawing on the growing surplus of unskilled labor. White large scale farming operations characteristically were viewed as "scientifically" modern operations (e.g., large scale monoculture of hybrid varieties with intensive pesticide use). These characteristics of commercial agriculture in South Africa have led to large numbers of farm workers being directly and indirectly exposed to pesticides through spraying operations; working in the fields with little, if any, protective measures; and living next to sprayed fields. Farm workers are exposed, not only to intense spraying operations, but also to a range of highly toxic chemicals.

2.3.2. Women in Agriculture

Another characteristic of the agricultural sector in South Africa, as in much of the developing world, is the high level of participation of women (and children) in both formal and informal production (Sekimpi 1993; Gitonga 1991; Munguti 1993; Lipton et al. 1996b). It is estimated that in rural South Africa, women constitute 70 percent of total labor used in farming activities and that 90 percent of hired labor is provided by women[7] (Lipton et al. 1996b). However, women are marginalized in the agricultural labor force where their contribution is seen as less skilled than that of male farm workers and where their work is viewed as less strenuous, dangerous or demanding than that of male farm workers. As the discussion of risk perception unfolds in this dissertation, the influence of

[7] The percentages referred to here relate to the number of persons working and not to labor time.

the gendered nature of the agricultural labor context on the gendered aspects of the perception of pesticide risk will become evident.

2.3.3. Pesticide Use in South African Agriculture

Although buyers of pesticides are required by law to register their purchases and indicate the intended purposes, annual pesticide use statistics for various users in South Africa are not available because use registers are not presently required by law to be kept, and previously any such information that did exist was considered confidential and not for public perusal (Naidoo and Buckley 2003; Rother and London 1998). Thus attempts to discuss pesticide use are generally limited to discussing pesticide sales (see Table 1).

2.4 HUMAN HEALTH EFFECTS ASSOCIATED WITH AGRICULTURAL PESTICIDE EXPOSURE

The likelihood that a particular health effect may occur from a pesticide is affected by the toxicity of the compound, as well as the exposure that took place (Wesseling 1997). In this section I will first discuss the factors affecting South African farm workers' exposure to pesticides, and then discuss the factors affecting the health outcomes from those exposures.

2.4.1. Exposure to Pesticides

Farm workers are exposed to pesticides directly (e.g., mixing pesticides, applying pesticides, cleaning spray equipment, splashes and spills) and indirectly (e.g., harvesting sprayed crops, drift, walking barefoot or bare-legged in sprayed fields, washing

contaminated clothes[8], re-using an empty pesticide container; London and Myers 1995a; Wesseling 1997). These exposures occur both at work (i.e., occupational exposures) and at the farm workers' homes (i.e., non-occupational residential exposures). Although this dissertation predominately focuses on the farm workers' occupational context, it is recognized that residential exposures occur and affect the total exposure of farm workers. Exposure situations vary widely from broadcasting a granulated pesticide by hand, applying a liquid pesticide in a leaking backpack sprayer, or inhaling pesticides sprayed[9], to working in a recently sprayed field or washing contaminated work clothes.

Exposure assessment should firstly include the degree of exposure. All exposures (direct or indirect; occupational or non-occupational) can be categorized as:

- Acute: high-level short term exposure resulting in relatively immediate poisoning; or
- Chronic: low-level repeated exposures to pesticides (e.g., over time - months or years) contributing to or causing health effects that only appear after a certain amount of time has passed and a certain amount of exposure has accumulated.

Exposure assessments should secondly include the route of exposure. Although there are four main exposure routes (dermal, oral, respiratory and ocular), the primary exposure route for farm workers in contact with commonly used agricultural pesticides is dermal (i.e., the skin) and not respiratory as is commonly believed (Moses 1989). Agricultural farm workers, according to Moses (1989), are four times more at risk of work-related skin disease than workers in other industries.

Exposure assessments should furthermore include the type of pesticide (i.e., the mode of action of the active ingredient(s) and the hazardous inert ingredients) that the

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[8] On some farms, the wives of the farm workers wash the contaminated clothing at home.

[9] Approximately 85-90 percent of pesticides sprayed for agricultural purposes never reaches the target organisms, but instead diffuses into the air, soil and water (Moses et al. 1993).

farm worker is exposed to. For example, organochlorine pesticides are soluble in fat and thus can be stored in the body's fat cells (Reigart and Roberts 1999); the danger is that when these fat cells break down from illness or weight loss, an individual may become very ill from the effects of the stored pesticide. As another example, organophosphates commonly used in agricultural production are neurotoxins acting primarily by phosphorylation of the acetylcholinesterase enzyme (AChE) at nerve endings (EPA 1999). This enzyme is needed for the control of nerve impulse transmission, e.g., from nerve fibers to smooth and skeletal muscle cells, as well as within the central nervous system (ibid). Thus, some of the symptoms of organophosphate poisoning include headaches, tingling fingers, muscle twitching, nausea, seizures and loss of consciousness.

Farm workers, in general, are likely to experience increased pesticide exposures because of their lack of information about, and awareness of, the toxic effects of pesticides; their lack of access to protective equipment; and the socio-economic conditions they live and work in (London et al. 2002; Moses 1989). Furthermore, exposure assessment in developing countries faces difficulties "where reliable and valid data from biological monitoring and environmental surveillance among working populations are usually nonexistent" (London 1998).

2.4.1.1. Farm Women's Exposure to Pesticides

Women farm workers' exposures to pesticides are often misperceived and underestimated because of their gendered production tasks (e.g., working in a sprayed field is not considered an exposure; see Chapter Five). Women farm workers may be at particular risk from pesticide exposure for three reasons. First, their triple responsibility for domestic maintenance (i.e., residential uses of pesticides, such as household

insecticide sprays), subsistence production (i.e., garden uses of pesticides) and agricultural employment (i.e., both direct and indirect exposures) means they are potentially exposed in three different areas of their lives to a variety of pesticides. Second, the triple responsibility women bear diminishes their health and decreases the ability of their bodies to resist toxicological impacts. Third, according to London et al. (2002), during pregnancy, women are especially vulnerable to chemical hazards because of increased undernutrition and increased risk of fetal sensitivity leading to potential complications (e.g., miscarriages, still births). In addition, chronic undernutrition and ergonomic hazards (e.g., eye strain, repetitive motions) may interact with the hazards posed by chemicals, increasing still further the risk for women farm workers (Ibid). Further, according to Repetto and Baliga (1996), the effects of exposure to pesticides (e.g., stress, weight loss, alteration of the immune system) may compound the potential health risks for farm workers from infectious and parasitic diseases common in developing countries.

2.4.2. Pesticide Health Concerns

The toxicity of pesticides varies greatly from one pesticide to the next, resulting in a diversity of health effects including topical lesions of eyes and skin (contact dermatitis); respiratory impacts (lung damage); immunologic, neurological, and developmental effects; reproductive dysfunction; endocrine disruption; and several different types of cancer (Repetto and Baliga 1996; Colborn et al. 1996; WHO/UNEP 1990; Baker and Wilkinson 1990; Hayes and Laws 1991). The toxicity of an individual pesticide can also be influenced and altered (e.g., increased or decreased) by several factors such as

temperature, wind and light (e.g., *aldrin* and *dieldrin* exhibit a higher toxicity at higher temperatures; Schwab et al. 1995).

The health concerns with pesticides are that exposures can cause both acute effects (e.g., headaches, skin rashes, tremors, blurred vision, convulsions, vomiting, difficulty breathing) and chronic effects (e.g., some cancers, endocrine disruption, spontaneous abortion, death of fetus in utero, birth defects, developmental and behavioral problems, decreased fertility, neurobehavioral problems). Although neither acute nor chronic effects have been adequately studied in terms of occupational health for farm workers (Moses et al. 1993), research on chronic effects of pesticide exposure is particularly limited, especially for the developing world context (London et al. 2002; London and Rother 1998).

Between 100 and 200 cases of pesticide poisonings are reported every year to the South African National Department of Health; the majority involve farm workers and their families, with children forming a large proportion of the victims (London et al. 2002; Pesticidal Poisonings in South Africa 1995). However, a number of studies have shown that the true rates of poisoning are anywhere from five to 20 times higher than what is officially reported (Coetzee 1981; Emanuel 1992; London et al. 1994; London and Myers 1995a). Under-reporting of pesticide poisonings in South Africa is due to a poor surveillance system (see discussion of legislation in section 2.5.3.1), lack of recognition of poisoning symptoms both on the part of medical professionals and farm workers, and lack of awareness of potential pesticide exposure effects.

2.5. REGULATION OF AGRICULTURAL PESTICIDE USE IN SOUTH AFRICA

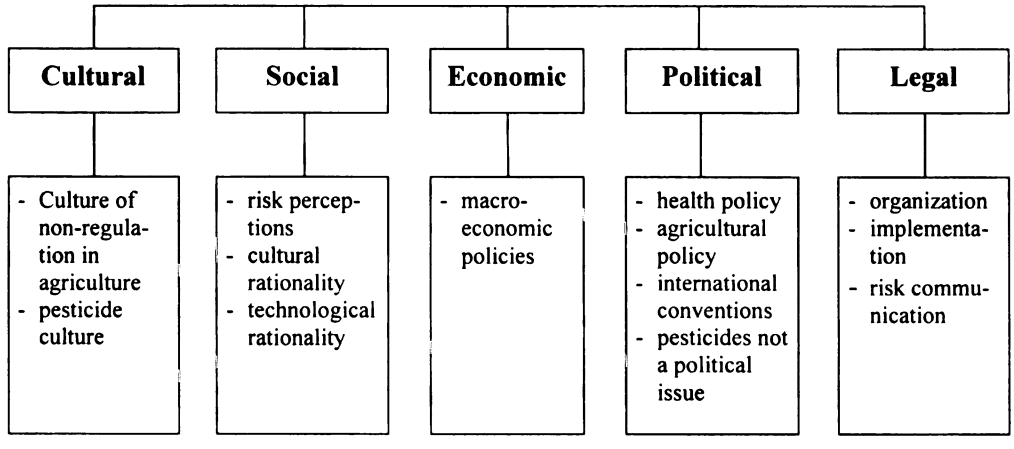
This section discusses the various levels and mechanisms of regulation of pesticide use and usage in South Africa, highlighting both what these levels and mechanisms are, as well as why these are not working. This section focuses on the contextual mismatch between the mechanisms and the macro-social context. The next section (2.6.) will discuss the inherent and immanent problems in the mechanisms transferred to the South African context (i.e., competing technological and cultural rationalities, and potential problems with pesticide risk communication).

2.5.1. Pesticide Risk Management Mechanisms and Shortfalls

In light of the potential health effects associated with pesticide use, international and national regulatory structures and protective mechanisms exist for the ostensible purpose of protecting South Africans from pesticide poisonings. This regulatory structure covers multiple jurisdictions and relies on multiple mechanisms to control many facets of pesticide use, such as the importation, formulation, exportation and use of pesticides in South Africa. However, despite the existence of these health and safety protection mechanisms, pesticide poisonings continue in South Africa. This is because pesticide protection mechanisms fall short and have limited effectiveness. There are two main types of ineffectiveness of pesticide protection mechanisms. Ineffectiveness results in part from a mismatch between the mechanism and the macro-social context, but ineffectiveness also results from a technological rationality that is inherent or immanent in the mechanism itself and that clashes with a cultural rationality that exists in the target social actors.

Although this section highlights the various pesticide protection mechanisms within South Africa, this research specifically focused on a micro-social analysis of the effectiveness of pesticide labels as a risk communication tool for farm workers. This analysis is placed in the macro-social context within which these hazard communication tools are designed, implemented and used. The cultural, social, economic, political, and legal dimensions of pesticide use in South Africa are discussed within a historical context in order to understand farm workers' pesticide risk perceptions and the role of pesticide labels as a risk communication tool. Figure 3 illustrates these contextual influences relevant for this dissertation research.

Figure 3: Contextual Factors Influencing Pesticide Protection Mechanisms



The contextual factors that inhibit the effectiveness of agricultural pesticide labels in South Africa will be discussed in this section. The ways in which technological rationality leads to ineffective communication will be discussed in the next section, section 2.6.

2.5.2. International Pesticide Protection Mechanisms

International pesticide policies, guidance documents, conventions and standards are mechanisms designed to protect those using and/or indirectly exposed to pesticides. These are predominately United Nations (e.g., FAO, WHO, ILO) or industry designed mechanisms. The main international conventions affecting pesticide use in South Africa are presented in this section within a discussion of the political context in South Africa. The political context includes both national and international governance structures. Issues pertaining to the implementation of national laws and regulations are discussed below in section 2.5.3.

2.5.2.1. Relevant International Conventions and Negotiations

South Africa participates in several relevant international negotiations on pesticides; however, the government lags in official commitment to these international conventions through ratification. A good example of this is the Rotterdam Convention on Prior Informed Consent (PIC) for the exportation and importation of pesticides, which was opened for signing in 1998. South Africa, however, only signed and ratified the PIC Convention in August 2002 prior to hosting the World Summit on Sustainable Development (WSSD).[10]

Although South Africa received funding to set up a National Profile for Chemical Management, under which hazard communication tools would fall (i.e., harmonizing hazard communication tools through a United Nations initiative, see footnote 53), to date the National Department of Environment and Tourism (DEAT) has failed to complete a

[10] The signing of the Convention came suddenly and as a surprise as the South African government showed limited commitment to the Convention or intention to sign prior to WSSD. The signing appears to have been sparked by the need to illustrate to the world that South Africa was supportive of United Nations negotiations and conventions before hosting the WSSD.

National Profile[11] (the process stopped in 2000 and began again in 2002). Thus in South Africa there is no official registry of the production, uses, importation, or exportation of pesticides, or of the quantities thereof.

2.5.2.2. Relevant International Standards

For classification of pesticide risks, South Africa relies on international standards that are based on technological rationality and determined by the World Health Organization (WHO). Following the lead of the Council of Europe in 1984, the WHO and the United Nations Environmental Program (UNEP) in 1990 grouped pesticides by the degree of hazard into four classes based on the LD50[12] of the product. This "hazard" class grouping of pesticides (i.e., the level of toxicity) has been incorporated into South African legislation and is represented on the pesticide labels as color codes. The four GIFAP (now Crop Life International) hazard classification groups are represented by the colors red, yellow, blue and green ranked in order from most toxic (Group Ia and Ib - red) to least toxic (Group IV – green).

2.5.2.3. International Pesticide Code of Conduct for Industry and Safe Use Initiatives

International agencies, in collaboration with national governments, have over the last 20 years relied on "safe use" approaches to minimize pesticide risks in developing countries. According to Wesseling et al., "safe use" is defined as "the use of dangerous substances in the absence of adverse health or environmental effects" (2002:1). The most imperative of these initiatives has been the International Code of Conduct on the

[11] DEAT attempted to have a completed document to release at WSSD, but failed to do so.

[12] The oral or dermal lethal dose (LD) of a chemical required to kill 50 percent of the test population (e.g., rats). This is measured by the number of milligrams of active ingredient per kilogram of body weight required to kill 50 percent of the test animals.

Distribution and Use of Pesticides of the United Nations Food and Agriculture Organization (FAO)[13], and the "Safe Use Initiative" of Crop Life International (formerly Global Crop Protection Federation – GCPF, and prior to that the International Group of National Associations of Agrochemical Manufacturers – GIFAP).

The premise of these initiatives has been industry's and the FAO's technological rationality that views pesticides as indispensable and claims that if they are "properly" handled and used, then no unreasonable harm will be caused.[14] Wesseling et al. (2002:1) argue that the justification for this premise is that "collateral damage of pesticide use has been attributed primarily to insufficient regulation and the ignorance of pesticide users in developing countries". Further, they (ibid.) suggest that "it has been assumed that strengthening of regulations and education of users would lead to an acceptable level of pesticide safety"; this might be done through activities such as risk communication. However, these initiatives were conceived in the 1960's and 1970's in direct response to Rachel Carson's criticism in *Silent Spring* (1964) of the industry's technological rationality of uncontrolled pesticide use with the premise that pesticides are "safe". Industry's assumptions are that pesticide problems, such as those highlighted by Carson, are caused by improper behavior and this can be corrected through fostering more rational and common sense understanding of "the facts" of pesticides (Murray and Taylor 2001).

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[13] The FAO Code of Conduct was developed in close collaboration with GIFAP (the global pesticide industry body) despite criticism from various non-governmental organizations and others (Murray and Taylor 2000). This Code of Conduct, first issued in 1985 and revised in 2003, aimed to strengthen national governments' pesticide registration and regulation.

[14] For more information, see: http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm and http://www.croplife.org.

However, as is argued in this dissertation, pesticide risk related behavior is not influenced solely by the linear flow of technical rationality, but instead is influenced by the interrelationship between cultural rationality and technical rationality resulting sometimes in very hazardous behaviors in regards to pesticides. This "safe use" concept also permeates most of the South African pesticide training initiatives that presently are run by government and industry. This became evident from the data collected for this dissertation (see Chapters Five and Six).

Concrete evidence of the effectiveness of safe use measures is lacking (Murray 1994; Kishi et al. 1995) and there are suggestions that the effect may be counter-productive. "This safe-use strategy has been characterised as a paradox, because it actually promotes and increases the use of pesticides without preventing or controlling the adverse effects as claimed" (FDA 1989; Wesseling 1997). Similar initiatives in Kenya by GCPF have proved to increase pesticide use, as the underlying message is that if used "correctly", pesticides are intrinsically "safe" (personal communication with GCPF representative from Kenya 1994; Garcia 1998).

The approximately 165 South African pesticide companies are represented by two main umbrella organizations -- the Crop Protection and Animal Health Association (AVCASA; representing pesticide companies) and the Chemical and Allied Industries' Association (CAIA; representing pesticide and industrial chemical companies). These associations adhere to and comply with the FAO Code of Conduct, as well as supporting the standards recommended by the global pesticide industry (Rother and London 1998). When companies become members of either of these two organizations, part of their membership requirement is agreeing to adhere to and support these organizations'

responsible use (AVCASA) and *responsible care* (CAIA) global stewardship philosophies and initiatives. These initiatives embrace the "safe use" philosophy described above, but are rephrased to reflect a more "caring" approach. These initiatives were developed and embraced by the global chemical associations as a means to change the public view of the industry from a perception of ruthless and uncaring profit pursuers, to one of trust, honesty, and credibility (Hook 1996). This safe-use strategy, and especially the educational/training component, is also seen by industry as a means to prevent negative health and environmental consequences from pesticide use (World Health Organization and UNEP 1990). The message given by industry is: just read the label, use as directed, use personal protective equipment (PPE) and pesticides will do no harm to humans or the environment.

At present there are no national regulations or legislation for what specifications in general are required on legally registered South African pesticide labels and their corresponding information inserts. Thus the information content, design, pictograms and layout are governed by the FAO Code of Conduct and GIFAP.

As highlighted by the above discussions, international pesticide policymaking is dominated by the chemical industry's needs and demands. Thus one has to question whether the international protection mechanisms are suited to protecting farm workers in South Africa.

2.5.3. National Laws and Regulations

South Africa's first pesticide legislation was enacted in 1947 (see Table 2), however, the first restrictions on specific types of pesticides only came into effect in the 1970's. In the next section I will describe the provisions of the South African pesticide

TABLE 2: A Short Guide To The Laws Affecting Pesticides In South Africa

LAW	DEPARTMENT	AIM AND CONTENT
Fertiliser, Farm Feeds and Agricultural Remedies Act No. 36 of 1947*	Agriculture	* Establishes a Registrar's Office * Registration of Pesticides * Toxicity classification * Registers Pest Control Operators * Controls labeling, advertising, disposal, sale, importation and use of pesticides (under review)
Agricultural Products Standards Act No. 119 of 1990	Agriculture	* Maximum residues of pesticides permitted in products intended for export follows EU Harmonised Chemical List and Codex Alimentarius
Agricultural Pests Act No.36 of 1983	Agriculture	* Control of import of foodstuffs that may contain pests * Allows the Department to spray to eradicate pests
Conservation of Agricultural Resources Act No. 43 of 1983	Agriculture	* Provides for the use of weeds killers to combat weeds and invader plants at the discretion of the Department * Allows inspectors to enter premises to determine the extent of water pollution by farming activities
Health Act No. 63 of 1977 (Health Bill 2003)	Health	* All poisons to be notified to the Department * Local authority health inspectors can control health hazards, follow up poisonings (under review)
Hazardous Substances Act No. 15 of 1973	Health	* Classification of Hazardous substances * Measures for disposal and procedures to follow * Prohibits use of Class 1 hazard containers for any unintended use (water or food storage or cooking)
Medicines and Related Substances Control Act No. 59 of 2002	Health	* Registration of medicines containing pesticide agents for human use
Foodstuffs, Cosmetics and Disinfectants Act No. 54 of 1972	Health	* Maximum residues permitted in foods (fresh foods only) * Generally follows CODEX Alimentarius directives for residues
Occupational Health and Safety Act No. 85 of 1993	Labor	* General obligation on employers and employees for a safe workplace * Establishes health and safety representatives and committees
Hazardous Chemical Substance Regulations No 5549 of 1995	Labor	* Rights to information and training * Obligation to do workplace environment and workers health * Hierarchy of controls to prevent chemical exposures * Rights to protective clothing and equipment
Compensation for Occupational Injury and Disease Act 1993	Labor (compensation Commissioner)	* Covers compensation for work-related poisoning by pesticides
National Water Act No 36 of 1998	Water Affairs and Forestry	* Control of discharges into water sources * Licensing of waste disposal sites * Follow the International Maritime Dangerous Goods Code (IMDG 1993) for control of pesticides on ships

TABLE 2 (Continued):		
LAW	**DEPARTMENT**	**AIM AND CONTENT**
National Environmental Management Act No 107 of 1989	Environmental Affairs and Tourism	* General environmental provisions * Control of litter and waste * Control of emergency incidents * Protection of workers refusing to do environmental hazardous work * Waste Management * Air Pollution control * Responsible authority for Prior Informed Consent (PIC)
Customs and Excise 1964	Trade and Industry	* Import and export of goods including pesticides
National Road Traffic Act No. 93 of 1996	Transport	* Transport of Dangerous Goods

*Shaded laws are the main pesticide acts in South Africa.
Source: Adapted from Rother and London 1998

legislation. In the following section (section 2.6) I will discuss several types of contextual factors that interfere with the effectiveness of the pesticide risk management legal provisions.

2.5.3.1. Provisions of National Legislation, Regulations and Standards

Various national laws, regulations and standards exist to protect humans and the environment (see Table 2). For example, the main national pesticide act, the Fertiliser, Farm Feeds and Agricultural Remedies Act 36 of 1947, controls pesticide labeling and registration issues aimed at protecting human health and the environment, as well as fostering product efficacy. Another piece of national legislation focusing on safety in the workplace is the Occupational Health and Safety Act (OH&SA) of 1993. Under this piece of legislation are the Hazardous Chemical Substances Regulations (HCSR; No. 5549 of 1995) which outline specific duties of employers and employees to prevent chemical exposures, ensure a safe working environment, and protect workers from ill effects of pesticides. Under OH&SA and HCSR, farm workers have rights to

information, training, workplace risk assessments, and the monitoring of their health, as well as access to a hierarchy of controls for preventing chemical exposures (e.g., reducing hazardous exposures, changing chemicals used to less dangerous ones, reducing time of exposures, increasing ventilation in a mixing area, and, as a last resort, personal protective equipment [PPE]).

Government laws and industry protocols also mandate the use of hazard communication tools (i.e., labels and material safety data sheets [MSDS's]) as vehicles for communicating to end-users the technical data on the hazards and risks associated with pesticides. These communication tools will be discussed in much greater detail in the following section of this chapter (section 2.6).

2.5.3.2 Factors Inhibiting Effectiveness of National Legislation, Regulations and Standards

Three types of factors inhibit the effectiveness of South Africa's national laws, regulations and standards. The first of these is the orientation of the legal provisions. Pesticide legislation in South Africa was primarily developed to ensure product efficacy and product quality, not to guarantee human and environmental health and safety. For example, the pesticide *Atrazine* was withdrawn from use on heavy clay soils in 1977 because of poor efficacy; whereas, *Vinclozolin* was only withdrawn from registration in 1995 due to health hazards to applicators (NDA 2003). The latter restriction was the first mention in pesticide registration restrictions of a withdrawal based on a potential human hazard.

The second type of factor inhibiting the effectiveness of pesticide risk management is the political context. A political contextual issue contributing to the ineffectiveness of pesticide protection mechanisms is that pesticide issues in South Africa

are not viewed as a political issue. That is, the government does not classify pesticide health hazards and environmental contamination as significant enough an issue to warrant political support when South Africans are suffering from AIDs, unemployment and increased crime. The lack of surveillance data (see below) contributes to this lack of political support as policy makers are ill informed.

The third type of factor inhibiting the effectiveness of pesticide risk management provisions is the legal and government organizational context. Seven organizational factors contribute to the ineffectiveness of legislated pesticide regulatory provisions (for additional discussion see Rother and London 1998).

Fragmentation of legislation; Absence of Regulatory Oversight Body. Legislated measures are limited in protecting people from pesticide exposures and poisonings because of the way in which pesticide legislation and regulations are organized in South Africa (London and Rother 2000). With 14 pieces of pesticide legislation, governed by seven different government departments (see Table 2), no one governmental unit takes responsibility for, or oversees, the broader issues of pesticide use and control (e.g., as is the case with the U. S. Environmental Protection Agency). Existing legislation is fragmented, resulting in gaps and loopholes, along with ambiguous and contradictory responsibility amongst regulatory government departments.

Dual role of main pesticide regulatory body. The main piece of pesticide legislation, Act 36 of 1947, is housed in the Department of Agriculture. As noted above, regulation of pesticides in South Africa was originally designed for product efficacy and protection of trade secrets, not for the protection of human health and the environment. In post-Apartheid South Africa, in carrying out its task of pesticide registration, the

Department of Agriculture struggles to balance benefiting the pesticide industry with protecting humans and the environment (London and Rother 2000). Jasanoff (1998) indicates how agencies that are responsible for both the promotion and the regulation of a technology (e.g., the U.S. Nuclear Regulatory Commission) are more tolerant of risk than those agencies whose mandate is solely regulation (e.g., the U.S. Environmental Protection Agency). Thus, how the governance structure of a society deals with risk is directly related to the way in which governmental authority is institutionalized. Hence, in South Africa the Department of Agriculture presents pesticides as not posing a great risk to human health or the environment.

Inappropriate toxicological data used for pesticide registration. There is organizational failure, both in South Africa and globally, to recognize the differences between contexts where pesticides are used. Consequently, registration procedures in South Africa incorporate the toxicological and environmental data from tests on pesticides conducted in Northern developed countries with differing climatic, environmental, social and human contexts. Thus pesticides are registered in South Africa based on risk assessments that are socially and ecologically framed outside of the country, which may be inappropriate for protecting human health and the environment in South Africa (see further discussion in Rother and London 1998).

Inadequate safety coverage from pesticide toxicity classification. In South Africa, pesticides are classified according to the WHO classification of toxicity under Act 36 of 1947. This classification is based on the laboratory studies discussed above, in section 2.5.2.2. and is represented on pesticide labels in the form of a color band. However, this method of classification covers acute effects only and does not take into account possible

chronic effects occurring from lower levels of longer-term exposure. Until recently, this toxicity classification was only for the active ingredient(s) found in the pesticide and not for the so-called inert ingredients (other compounds used in the formulation of the pesticide). According to the registrar of the National Department of Agriculture (Wolmarans 2002), all pesticides registered now in South Africa are classified according to the total formulation; however, whether this is truly occurring is difficult to prove. Also, the registrations of all the pesticides previously registered have continued in force even though they were registered on the basis only of the toxicity of the active ingredient and have not been subject to a total formulation analysis. This implies that end users will not be able to distinguish between labels whose risk information represents the active ingredient versus those whose information represents the total formulated product as labels do not include the date of registration. Government is covering themselves by stating that color code represents the formulated product, however, many products on the market (if not most) are labeled only for the toxicity of the active ingredient.

Lack of monitoring of compliance. Existing legislation and regulations lack enforcement as government departments assume other departments are responsible for inspections and monitoring, and government departments lack the resources (e.g., staff, funds) needed for enforcement (Emmanuel 1992). Inspectors are tasked with too many competing responsibilities, with pesticide issues taking a low priority (personal communication from National Department of Labor and National Department of Agriculture 1996). Although South Africa has a modern structure of pesticide regulation, without adequate monitoring of implementation and enforcement (see next section) this legislation becomes vacuous.

Insufficient Penalties and Limited Enforcement of Penalties. Currently legislated penalties for non-compliance or misuse of pesticides are in the form of fines. However, penalties are not frequently imposed (Barlin-Brink 1991) and when they are enforced the monetary penalties are so low, that for the offenders (e.g., industry or large scale farming operations), they serve as no deterrent (personal communication from Dr. Verdoorn, Poison Working Group on the Endangered Wildlife Trust 1996). Thus the real penalties for violating legislation do not provide sufficient punishment to create a disincentive for not protecting human health and the environment.

Insufficient surveillance of outcomes to inform policy. There is a lack of awareness amongst policy makers, public servants, industry, and the general public that existing pesticide risk protection mechanisms are not working as intended (Barlin-Brink 1991). One of the main factors contributing to this lack of awareness, and the consequent assumption that regulatory pesticide protection mechanisms are working, is the lack of adequate, effective and gender sensitive surveillance strategies in South Africa (London et al. 2002). Currently available pesticide poisoning data underestimates the actual poisoning cases by five to 20 times and disproportionately underestimates women's poisoning incidents (London and Bailie 2001; Emanuel 1992; Coetzee 1981). Although pesticide poisonings are a medically notifiable condition in South Africa, under-reporting occurs from misdiagnosis and non-compliance (London et al. 1994). This underreporting in turn creates the understanding that pesticide poisonings are not a problem in South Africa and the result is that pesticide use problems are not an issue receiving political support.

In addition to the legal, political and organizational factors, three other groups of contextual factors inhibit the effectiveness of South African pesticide risk management mechanisms. The following three sections discuss the cultural, economic and socio-ecological contexts of pesticide risk management.

2.5.4. Cultural Context

Historically there has been a culture of "non-regulation" of agriculture in South Africa favoring white commercial farming operations and agribusinesses (see section 2.3.1.). According to Ball (1990), agricultural "regulation" was meant to guarantee maximum profit for pesticide companies and white farming operations, to ensure protection of the agrichemical industry (e.g., no enforcement of legislation against bad practices, no transparency, no enforcement of safety practices, no worker rights), to ensure protection of farmers (e.g., assured good prices, cheap credit for purchasing agricultural inputs, a work force with no legislated rights), and to ensure that farm workers and factory workers had no rights and no voice (e.g., no union representation).

In this culture of non-regulation of agriculture, white farmers played an active role in making and implementing agricultural policy. Their role was to give advice that would be accepted and implemented, rather than to passively accept and comply with externally determined agricultural regulations (Lipton 1993). A former Director General of the South African Agriculture Department reported that, "We met the central Committee of SAAU [South African Agricultural Union[15]] monthly...They were the only outside body we regularly asked for advice about proposed policy changes" (Lipton et al. 1996a: 408). SAAU officials also confirmed that they had direct access to "the

[15] Most white farmers were affiliated with the SAAU, which represented and was a voice for white farmers throughout South Africa.

Agriculture Department, the Cabinet and even the State President, particularly during the golden years of the 1960's and 1970's" (ibid).

Not only did white commercial farmers play a significant role in South Africa's agricultural politics, but agribusinesses did as well. Lipton et al. (1996a) point out that the roles of the South African agricultural bureaucracy and of agribusinesses have been little studied as the culture of non-regulation was supported by a culture of secrecy and non-transparency, and the opaque manner in which business was conducted. Until recently, the Department of Agriculture's handmaiden relationship with the chemical industry (i.e., legislation and regulation favoring industry) went unchallenged (Rother and London 1998).

In 1993, regulations under the Occupational Health and Safety Act (OH&SA) were designed to protect farm workers exposed to pesticides. However, although the legislative prescription for monitoring and controlling hazardous work environments exists, labor legislation to support the implementation and enforcement of the occupational health and safety legislation lags far behind. Although over the past five years labor legislation in South Africa has brought the agricultural sector nominally in line with international standards (London and Rother 1998), the implementation of such regulations remains merely rhetoric given the culture of non-regulation that previously dominated the agriculture sector in South Africa (London and Rother 2000). The result is that the majority of farm workers in South Africa do not receive legislated protections and benefits on the farms where they work and continue to be exposed to hazardous conditions. The present law makes reference to generic protections, especially for factory workers, but there is no specific reference in the current labor legislation forbidding

hazardous activities in agriculture. For example, as recently as 1993, 20 percent of a sample of fruit industry workers reported serving as human markers for aerial spraying of pesticides (London 1995).

Furthermore, in South Africa there exists a "culture of pesticide use" which undermines pesticide legislation and health protection mechanisms through deep-seated beliefs and assumptions (Rother and London 1998). Generally, pesticides are embraced across the spectrum of end-users and other stakeholders (i.e., commercial farmers, small-scale/emergent farmers, farm workers, food processors and marketers, the general public, government departments) as effective in controlling and eliminating the various pest problems with minimal or no harm resulting from using the pesticides. There is a general belief that pesticides are "safe" and that government would neither allow the sale of, nor legalize, a chemical that is "really" harmful; thus, there is a blind faith that pesticide legislation is protecting human health and the environment (Rother 2000). This belief is further compounded by the fact that pesticides for household uses are readily available in most supermarkets and found extensively in urban and rural homes, but with limited availability of information on the associated hazards (Rother and London 1998). Thus, in many ways, the focus of public policy and cultural interpretation is still on the efficacy of pesticides and not so much on potential health and environmental effects.

Especially in the rural areas of South Africa, there is the belief that pests can only be controlled, and crops can only be produced, with the use of pesticides, and that there are no alternatives to pesticides; some even believe that the law requires pesticide use (Rother 2000). Many people in South Africa also believe that the economic loss that would be caused by not using pesticides, either in terms of export earnings for large scale

farming and/or in terms of subsistence and survival for poorer farmers, outweighs the potential human health hazards or environmental contamination from pesticide use (Rother and London 1998).

2.5.5. Economic Context

Pesticide health and safety protection mechanisms also fail when the priorities of authorities conflict with protection from pesticide hazards. For example, South Africa has a national macro-economic growth strategy to increase production by small-scale and emergent farmers supplying an export oriented economy (Agricultural News 1997), thus encouraging an increase in pesticide use without necessarily increasing pesticide health and safety measures.

As noted above, historically, the South African government and the pesticide industry have had a close and undisclosed relationship, whereby industry was "protected" as a means of enhancing its contribution to the national economy (Rother and London 1998). However, this relationship is contrary to the post-Apartheid constitutional policy objectives of transparency and public participation in policy. Unfortunately, to date, this contradiction has not led to any changes in pesticide policy, with most of the existing protective measures still being ineffective.

2.5.6. Social and Ecological Context

The final contextual reason why existing pesticide protection mechanisms are not working is that the health and environmental toxicological data (i.e., the technological rationality) used in reviewing pesticides for registration are inappropriate and inaccurate for the South African climatic conditions, and for the social and cultural context. As

Jasanoff (1998) indicates, policy makers tend to make scientific claims about the data used for standard setting; the premise of these claims is that standards can be set on the basis of "universal" and "pure" or completely objective technical analysis ignoring physiological, climatic and social variations. Most of the risk assessment data are generated in the home country of the transnational chemical company that originates the pesticide, and are based on tests extrapolated to healthy males in climatic conditions of Northern countries (Thrupp 1994). Hence, they are not appropriate for women, or children, or the old or malnourished or immune deficient subpopulations that are significant components of the agricultural labor force in developing countries (Rother and London 1998; Thrupp 1994). As Wesseling et al. (2002: 3) point out, "often the interpretation of the toxicological, epidemiological, and exposure assessments data underlying risk management decisions in developed countries are [sic] clearly erroneous".

Another implication of climatic variation is that pesticides used in South Africa are exposed to intense heat conditions. Subsequently, many pesticides exposed to heat (especially the currently common organophosphates) break down quickly into more toxic metabolites (Hirahara et al. 2001).

2.6. TECHNOLOGICAL RATIONALITY, CULTURAL RATIONALITY AND COMMUNICATION

Both technical and sociocultural understandings of risk influence risk decisions and the communicating of risks. Although technological rationality and cultural rationality are in competition with each other, they are not mutually exclusive of one another. For example, practitioners often attempt to use technological rationality to

influence cultural rationality through risk communication initiatives such as industry training on the "safe use" of pesticides. This section presents a discussion of technological and cultural rationalities in order to highlight some of the issues influencing the interaction between risk communication and risk perception.

2.6.1. Technological Rationality

2.6.1.1. What is Technological Rationality?

As described in Chapter One, technological rationality is a "risk orientation that is guided by values of science such as quantification, objectification, and comparison across cases" (Hamilton 2003: 293). Often termed in the risk literature as the "expert view" of risk, technological rationality does not consider cultural assessments of risk to be a part of risk. Instead, technological rationality measures risk based on biogeophysical hazards through methods such as risk assessments, rather than measuring social or political risk consequences. The argument for the technological rationality of risk is that this orientation presents risk "objectively", "scientifically", and as "just the facts". Consequently, the "experts" are presented as more capable than the "laypersons" to assess the "real" risks associated with a hazard. In the case of pesticides, this argument appears convincing because, in order to assess pesticide risks, biochemistry, chemical fate and mode of transport need to be understood. However, as Vaughan and Seifert (1992) argue, societal members (whether "expert" or "lay") frame risk experiences based not just on "facts" but also on underlying values and beliefs which could influence risk responses and foster competing perspectives. Thus varying frames are able to lead to varying definitions, reactions, solutions, and policies about risks in general and pesticide risks specifically (cf. Gamson and Modigliani 1989).

2.6.1.2. Risk Communication Tools and Technological Rationality

As Weyman et al. (1998:22) point out, historically

> "a fundamental assumption amongst technocrats, industrialists and legislators, has tended to be that a particular activity or process is free from substantial risk and that the public has a tendency to exaggerate risks. Such a view has generally led to the logical conclusion that effective communication about health and safety issues is all that is required in order to 'educate' the public regarding the true risks and benefits, to allay these 'irrational' fears."

When some inevitable hazard could not be eliminated from an activity or process, appropriate safety behaviors could effectively reduce the risk to an acceptable level. Thus the manifest intention underlying chemical hazard/risk communication tools is to convey to end-users and other recipients key information so as to trigger safety behavior (ILO 1991).

Interestingly, technological rationality appears to contain an internal contradiction. That is, on the one hand the manifest external function of part of the risk communication in the technological rationality view is to assure the laity in general that the activity or process of concern is free from risk. However, on the other hand the manifest internal function of another part of risk communication in the technological rationality view is to convince participants in the activity or process that it is hazardous and they need to engage in protective behaviors. Present pesticide risk management mechanisms make it possible for these two potentially contradictory messages to be fairly well segregated from each other (e.g., MSDS's are meant to be readily available, however, most laity are unaware of MSDS's). This dissertation, however, will only focus

on the second segment of pesticide risk communication, (i.e., the communication of potential hazardousness to users and proximate users).

2.6.1.3. Pesticide Labels and Technological Rationality

Many elements of the pesticide label are designed to communicate risk to the end-user. These are designed by the chemical industry to contain several key components for "communicating" hazard information about the product and to promote safety behaviors. That is, pesticide labels are intended to present the first alert to the end user that a pesticide is potentially hazardous. On pesticide labels, hazard messages are expressed through written text in the form of precautionary statements, hazard statements and first aid; through color codes to express the toxicity of the formulated product; and, especially for non-literate populations, through pictograms to express advice and warnings, and to indicate protective equipment to use.

In South Africa when a pesticide company submits an application to register a pesticide, the prospective label must accompany this application. The expectation is that pesticide labels (see Figure 4 and Appendices B, C, D, and E) contain some of the following categories of hazard information:

- A color code to express level of toxicity (i.e., hazard class);
- One signal word (such as harmful, very toxic) to express a hazard warning;
- First aid information for treating exposures to the chemical;
- Icons, such as the skull and cross bones or St. Andrew's Cross, to express a warning;
- Pictograms, to illustrate, especially to less literate individuals and persons from diverse cultures, precautionary measures to be taken when using this product; and
- Hazard information statements, such as "keep away from flames".

Figure 4: Removing a Pesticide Label



Source: Eric Miller, 2001

2.6.1.4. Problems with Pesticide Labels as a Risk Communication Tool

As explained above, hazard communication tools, such as pesticide labels and MSDS's, are designed by industry as mechanisms for transmitting information so as to protect humans and the environment from exposure to toxic pesticides. However, a number of factors in South Africa, as in many developing countries, render these tools ineffective. Cultural, political, economic, organizational, social and ecological contextual factors that impede the effectiveness of these tools were discussed in the previous section. Problems of literacy and communication, which interfere with the intended transmission of information, are discussed in Chapters Four and Six.

Technological rationality views the competing rationality (i.e., cultural rationality) as interfering with the accomplishment of the internal and external objectives of technological rationality mentioned above. However, the competition between the two rationalities operates to some extent differently between these two objectives. In the first, external objective, the cultural rationality of the laity counteracts the convincingness of

the "safe" message. In the second, internal objective, the cultural rationality of the workers and proximate workers counteracts the efficacy of the "hazardous" message (e.g., Arcury et al. 2002). However, it remains an open question whether cultural rationality is always in conflict with technological rationality, or whether cultural rationality and technological rationality can be complementary or coexist. To begin exploring this question, the following section will examine the characteristics of cultural rationality.

2.6.2. Cultural Rationality

2.6.2.1. What is Cultural Rationality?

As presented in Chapter One, cultural rationality is a risk orientation that "values experiential input, analogy, historical precedent, and democratic processes for decision making" (Hamilton 2003: 293). In contrast to technological rationality's top-down approach to risk decisions, cultural rationality embraces participatory mechanisms based on collective decision making in order to reach risk decisions. Often termed in the risk literature as the "lay view" of risk, cultural rationality in risk analysis focuses on the social and political context of risk (e.g., equity, distribution of power and control, trust in institutions). According to Plough and Krimsky (1987), cultural rationality places prominence on the social and political contexts for risk as these are seen to influence community judgments of risk.

2.6.2.2. Cultural Problems with Pesticide Labels as a Risk Communication Tool

Pesticide labels as a hazard communication tool transmit information in the form of a written language, as well as symbols and icons (see discussion in section 2.6.1.3). In

order for pesticide labels to be effective in protecting human health and the environment the following would be a necessary, but not sufficient, condition: hazard information is of a sufficiently universal and general nature that this information, and the medium used for communicating the information, can be understood by any person responsible for using pesticides regardless of their culture, level of education, literacy, language competency (especially in regard to scientific/technical language), and geographical location. At least implicitly, this assumption underlies South Africa's use of pesticide labels and their corresponding information inserts, both of which are developed and designed by the parent chemical industry (i.e., the multi-national chemical company usually based in Europe or the United States). That is, in expecting the label to fulfill its manifest internal function (safety behavior), it is assumed that the South African end-user will have had some exposure to formal education and be familiar with technical language/jargon, will know how to interpret symbols and color codes, and will know to look for and interpret warning information on the label. Since these assumptions are not usually the case, the hazard information is not being effectively communicated to the end-user.

In contrast to these assumptions, illiteracy amongst farm workers in South Africa is high (see Chapter Four). For those farm workers who are literate, the language used on the hazard communication tools is often not the language of literacy (e.g., pesticide labels are written in English and Afrikaans, not in any of the other nine official languages). When a farm worker can read the label language, the technical language (as describe above) used on hazard communication tools is often not comprehensible (e.g., "Dispose of container by *perforation*"; see Chapter Six).

In addition to cultural assumptions about language and communication, the cultural rationality perspective also highlights assumptions about values and interpretations. Another example of cultural rationality would be with priorities. That is, technological rationality assumes that for the pesticide user, personal safety is a paramount value. However, cultural rationality notes that when household income is scarce and insecure, maximizing production to satisfy real current needs (e.g., hunger, school fees, medical costs) takes precedence over some unclear, uncertain possible future effect from an intangible hazard. As Arcury et al. (2003) demonstrate, technological rationality assumes a culture of safety, whereas cultural rationality allows for a culture where taking risks is a source of pride and prestige (e.g., machismo).

2.6.2.3. Pictograms and Color Codes

The pesticide industry (i.e., Crop Life International) and the FAO designed pictograms for pesticide labels, especially for semi-literate and illiterate populations in all countries. The idea was that these symbols would pictorially inform the user of dangers, and protective measures/precautions to take, when using the pesticides. Similarly to pictograms, color codes were designed to bridge literacy problems in the transmission of toxicity classification information. The assumption is that the end-user will recognize the toxicity group (i.e., know how toxic the pesticide is) by observing the color band on a pesticide label, and will then engage in the protective behaviors appropriate for that group.

However, pictograms and color codes do not communicate a culturally and socially universal understanding of the messages they are designed to communicate. Also, end-users such as farm workers are not aware of and familiar with the importance

of hazard communication tools and the messages in them. Without training, farm workers have limited capability in understanding the technological rationally defined color codes and pictograms found on pesticide labels. However, even with training (language competence, symbolic meaning, information seeking), the cultural, social, economic, legal and political context may inhibit the farm worker's motivation to use that training and may motivate the farm worker to understand pesticides in ways that render that training irrelevant. Technological rationality assumes that users read instructions to assure their own safety; whereas cultural rationality in South Africa constructs the authoritarian assumption: if the government approved it and the farmer provided it, it is safe.

2.7. SUMMARY AND QUESTIONS POSED

South Africa increasingly relies on pesticide use in domestic and export agricultural production. Pesticides have been recognized to be a health risk for humans exposed in both occupational and non-occupational settings. Although pesticide legislation in South Africa is progressive and adheres to international laws and conventions, pesticide mortality and morbidity continues. This continuation of mortality and morbidity is largely due to the cultural, political, economic, legal, social, ecological and historical context of pesticide use in South Africa. Several protection mechanisms have been established to protect humans and the environment from pesticide hazards. One mechanism intended to communicate hazards associated with pesticide use, and thereby trigger protective behaviors, is the label found on pesticide containers which covers a range of risk information -- warnings, precautions, protective behavior advice,

and what not to do. This dissertation explores the effectiveness of the pesticide label in the cultural, political, economic, legal, social, ecological and historical context of South African agriculture.

Tensions between technical and cultural understandings of risk often characterize the risk disputes highlighted in the risk literature. Communication strategies also tend to reflect these varying perspectives with the premise that the expert view (technical rationality) needs to be transmitted to persons with the lay perspective (cultural rationality) in order to provoke appropriate safety behavior. In this view, risk communication tends to be a linear, one-way process from expert to layperson.

The study of the use of pesticide labels as a risk communication tool presents an interesting and apt case study in the analysis of the relationship between risk communication and risk perception, and the influence of this relationship on safety behavior. Therefore, this study poses the following questions:

- What are farm workers' pesticide risk perceptions? What are the social contexts within which these perceptions are formed and the processes affecting their formation?
- What are South African farm workers' perceptions of the relationship(s) between pesticides and their own and others' health? How does the pesticide label influence these perceptions? How does the pesticide label affect the processes of the formation of these perceptions?
- Do farm workers' pesticide risk perceptions influence their understanding of the pesticide labels and how they utilize risk information?
- Do farm workers' pesticide risk perceptions influence the effectiveness of pesticide labels as hazard communication tools?

The following chapter explores what the theoretical literature has had to say about risk perception and its formation, risk communication and its effectiveness, and the interaction between risk perception and risk communication. Subsequent chapters

describe the research that was conducted to explore these questions, and analyze the results from that research.

CHAPTER THREE

LITERATURE REVIEW

Two theoretical literatures were used in this dissertation in order to analyze South African farm workers' perception of risks associated with pesticides, the role of the pesticide label in communicating safety behaviors to these farm workers, and the interaction between farm workers' pesticide risk perception and the pesticide risk communication associated with the pesticide label. First, the risk perception literature provides the analytical framework within which to investigate farm workers' pesticide risk perception; second, the risk communication literature provides the framework for analyzing the role and effectiveness of the pesticide label. Within the risk perception literature, four theoretical orientations were used (the psychometric approach, the health belief model, the cognitive social psychological model, and cultural theory). From the risk communication literature, two theoretical approaches were used (social amplification and mental models). The risk perception and risk communication literatures provide the backdrop for analyzing the interaction between farm workers' pesticide risk perception and the pesticide label as a risk communication vehicle.

3.1. RISK PERCEPTION

3.1.1. Background to the Field

Within the social sciences, risk perception refers to people's beliefs, attitudes, judgments and feelings toward risk, and incorporates the wider social and cultural values and dispositions people adopt towards hazards (Slovic 1992; Pidgeon et al. 1992).

Hazards are defined in line with Kates and Kasperson (1983) as "threats to people and the things they value". Risk incorporates both the likelihood of a hazard emerging into an actual adverse effect, and the (perceived) severity of that effect -- loss, injury or some other form of danger (Krimsky and Plough 1988; see discussion on risk in Chapter One). This understanding of perceived risk is wide-ranging as it incorporates the idea that people evaluate the characteristics of hazards (e.g., social scale, locus of responsibility), rather than a single abstract concept (e.g., quality adjusted life years). Perception of risk is thus multi-dimensional implying that a particular hazard means different things to different people within different contexts. Pidgeon et al. (1992: 89) highlight that risk perception,

> ...cannot be reduced to a single subjective correlate of a particular mathematical model of risk, such as the product of probabilities and consequences, because this imposes unduly restrictive assumptions about what is an essentially human and social phenomenon.

In the field of risk perception there are several approaches to analyzing the content and formation of risk beliefs and attitudes. Results from risk perception research in North America, Western Europe and societies in transition (and to a lesser extent in developing countries) have informed policies regulating hazards and promoting health and safety by offering insights into how people think about and respond to risk.

The dominating social science literature on individual risk perception, including the four approaches used in this dissertation, was born out of the field of psychology. The early psychological work on risk perception and decision making in the 1950's and 1960's used a behavioral approach that drew fundamental assumptions from rational economic models of human action based on utility maximization. This early work

focused on the risks of gambling. Thus all risks (e.g., hazards to human health, residential destruction, technological disasters) were analyzed in the abstract as bundles of benefits and costs with varying probabilities. However, more valid approaches were sought as discontent grew with the *gambling paradigm* as it appeared to have little real world and ecological applicability (Brun 1994).

Toward the end of this period, Starr's (1969) work became important in contributing to the analysis of risk perception. He showed that people's behavior demonstrated "revealed preferences" indicating that there exists a degree of "risk acceptability", that is, a "perceived value trade-off, or equilibrium, between risks and benefits" (Weyman et al. 1998: 4). Starr's insights into how people perceive the concept of risk contributed to the shift in risk perception research in the 1960's and 1970's to *cognitive psychology* where more emphasis was placed on perception of, and responses to, potential technological risks (e.g., nuclear power, nuclear weapons, chemical disasters, industrial pollution).

Cognitive psychology structured its view of people's risk perception as the result of both external (framing) and internal (heuristic) influences. Weyman et al. (1998: 4) emphasize how this paradigm shift, spearheaded by Tversky and Kahneman (1974 and 1981), was the first real critique of the Paretian model of rationality previously used in explaining risk decision behavior. While maintaining the central premise that people actively evaluate risk(s) in terms of costs and benefits, this approach emphasized "errors" and "biases" in decision making about risk. That is, in the decision maker's process of conceptualizing, or forming the perception of, a particular risk, contextual biases or

"framing effects" and internal biases or cognitive heuristics cause deviations from a strictly rational, logical, objective decision (Tversky and Kahneman 1981).

According to Weyman et al. (1998), the identification of contextual biases (i.e., *decision framing effects)* has been perhaps the most significant contribution/finding of this early cognitive work on decision making. The concept is that the bias in risk perception results from the manner in which risk information is represented (framed) rather than from the application of heuristics (see next paragraph). Thus how the risk is framed is seen to influence interpretations of risk. For example, which is more risky: Being exposed to a pesticide where the probability of developing cancer is 80 percent or one where your expected lifespan is diminished by 20 percent?

Tversky and Kahneman (1973) did not, however, want to emphasize that human decision making was "non-rational" and they therefore tried to establish factors influencing perceptual biases. "Central to their explanation of the presence of misconceptions and errors in decision making is the notion that people rely upon a finite number of mental strategies, termed *cognitive heuristics*, in order to make sense of the world around them" (Weyman et al. 1998). "Heuristics" (seen mostly as representativeness, availability, and anchoring) are "rules of thumb" applied to diminish the complexity experienced when trying to understand prominent risk variables. Tversky and Kahneman (1973; 1974) argued that the heuristic of the *availability bias* (i.e., the ease with which risks are brought to mind because they are readily available in memory) was paramount for understanding risk perception over the heuristics and probability bias of representativeness and anchoring (Sjöberg 2000). The representativeness heuristic refers to evaluating risk based on similarities (e.g., Is risk A related to risk B? People

evaluate how representative risk B is to risk A; Tversky and Kahneman 1974). Anchoring is referred to as the "starting point bias" where risk is evaluated as the probability of one event in a sequence of events (Tversky and Kahneman 1974).

Behavior decision theorists (e.g., Tversky and Kahneman 1981; Levin et al. 1987) made significant contributions to the early research work on risk perception (e.g., the framing effect). However, despite these contributions, decision research seems to have taken a back seat in recent years because of the limited insights it offered (Pidgeon 1992).

Although the basic field of risk perception is seen as "mature" (Pidgeon et al. 1992), the social science literature on risk perception continues to be fragmented as scientists disagree about the concepts, tools and methods for documenting, analyzing and quantifying risk perception, especially in varying contexts. In its fragmentation, the risk perception literature spans the spectrum from the well-established empirical psychometric approach to the more theoretically oriented social and cultural approaches. When embarking on this dissertation research, no one approach appeared satisfactory in isolation from the other approaches for understanding South African farm workers' risk perceptions, especially because few of these approaches have been applied to subjects in a developing country context. Consequently, this dissertation draws upon the insights from the following four approaches: the Psychometric Paradigm, the Cognitive Social Psychological Model (CSPM), the Health Belief Model (HBM), and Cultural Theory.

3.1.2. The Psychometric Paradigm

Building on the knowledge about heuristics and framing effects from behavioral decision theory and cognitive psychology, and in reaction to greater public awareness of technological and environmental risks, work on risk perception shifted to evaluating and

mapping public perceptions of risk. The 'Decision Research Group' at the University of Oregon predominately developed the **psychometric paradigm** of risk perception, whose original thrust developed from Starr's (1969) efforts to design a technique for weighing technological risks against benefits to address the question, "How safe is safe enough?". Thus this paradigm, based on the work of Fischhoff and Slovic (Fischhoff et al. 1978 and 1983; Slovic et al. 1980, 1982, 1984 and 1986), centers on identifying societal risks which are of varying personal concern (i.e., developing "personality profiles" of individual hazards – Slovic 1992). Ottway and Tomas (1982) point out that a specific objective of psychometric research has been to understand the cognitive process underlying people's perception of the frequency, probability and impact of risks, while establishing how these perceptions are "biased" or contain "inaccuracies". Starting from earlier cognitive findings on "revealed preferences" and "risk acceptability", the psychometric approach relied on attitude research methodologies from psychology to reveal peoples' risk evaluations. From this work evolved the development of taxonomies of risk (or profiles of hazards) in order to explain how individuals arrived at judgments of subjective risk. That is, the concept behind these taxonomies was to explain people's "expressed preferences" by understanding those risks which people fear and those that they will tolerate (Weyman et al. 1998). Research findings based on this approach were then interpreted in the light of the earlier cognitive work on heuristics discussed in the previous section.

Wahlberg (2001: 240) appears to reduce the psychometric paradigm to an instrument by stating that the psychometric approach is "the almost paradigmatic research instrument in risk perception research" and that "the emphasis is mainly on

method within this approach, the assumptions being that human risk perception is multidimensional and can be measured by developing scales that reflect characteristics of risk that are important in shaping human (risk) perception". This paradigm extended researchers' previous knowledge about, and explanations of, how risk is understood. That is, why do some risks trigger more response, alarm, and anxiety than others? To comprehend people's understandings of risk, the psychometric paradigm presented new concepts (i.e., factors) for analyzing risk perception (e.g., terms such as "dread", "voluntariness", and "control" -- Slovic 1987; 1992). These new concepts were applied in order to understand risk perceptions through a process of scoring and mapping individual hazards and to produce quantitative measures of perceived risk (Slovic 1987). That is, hazards were characterized using numerous attributes that hypothetically influence the perception and acceptance of the associated risks. Several explanatory attributes of the perception of a hazard/risk are used by this model such as "New-Old", "Voluntary-Involuntary", "Dread", "Number of Exposed". The most significant factors influencing risk perception are summarized as the "fright factors" (see Figure 5), which subjects use to rate the risk of various hazards.

3.1.2.1. Psychometric Paradigm Methods

The basic psychometric paradigm is that hazards have properties (e.g., novelty, dreadfulness) and individuals perceive these properties; individuals integrate these properties in some way to arrive at an overall perception of the risk which is expressed through rating or ranking of risks. In order for individuals to rate and rank risks (i.e., to establish the various dimensions of risk), the psychometric approach uses questionnaires and factor-analytic procedures (Wahlberg 2001). A method used is to "calibrate" public

Figure 5: Fright Factors

Risks are generally more worrying (and less acceptable) if **perceived**:

- to be **involuntary** (e.g., exposure to pollution) rather than voluntary (e.g., dangerous sports or smoking)
- as **inequitably distributed** (some benefit while others suffer the consequences)
- as **inescapable** by taking personal precautions
- to arise from an **unfamiliar or novel** source (e.g., old versus new)
- to result from **man-made, rather than natural** sources
- to cause **hidden and irreversible damage** (e.g., through onset of illness many years after exposure)
- to pose some danger to **small children or pregnant women** or more generally to **future generations**
- to threaten a form of harm (e.g., death, illness or injury) arousing **much dread**
- to damage **identifiable**, rather than anonymous victims
- to be **poorly understood** by science
- as subject to **contradictory statements** from responsible sources.

Source: Fischhoff et al. 1978; Slovic 1986; Bennett and Calman1999

risk perception against "real" data, commonly mortality statistics (Bennett 1999). The psychometric approach demonstrates that risk perception is multi-dimensional and that the dimensions are measurable through developing explanatory scales that measure the characteristics of risks that are key in the formation of the perception of risks (McDaniels et al. 1995).

3.1.2.2. Criticisms of the Psychometric Paradigm

Despite the significant contributions made, many methodological criticisms of the psychometric paradigm exist. One is the influence on the research findings of the hazard sets (e.g., medical hazards, natural hazards, transport hazards) the researcher selects. For example, Brun (1992) demonstrates that choosing different hazard sets can lead to different factor structures; in his work he found that there is a different factor structure

for natural hazards as compared to anthropogenic ones. A second criticism of the psychometric paradigm is that the research findings are influenced by the dimensions used for rating the hazards. Pidgeon et al. (1992:106) explain how rating scales influence the research results by indicating that "questionnaire scales [common to most psychometric methods] are defined in advance by the researcher, [and] participants are not allowed to say what really matters to them about the question under investigation". A third criticism of the psychometric risk studies is that the research findings are influenced by the forms of statistical analysis adopted. Many multivariate techniques are available and used in psychometric studies, however, each highlight different aspects of the data set. Arabie and Maschmeyer (1988) explain how the factor analysis method employed in the original studies conducted by the Decision Research Group in Oregon did not highlight differences between individuals which may exist. The choice of hazard sets, rating scales and statistical analysis in the psychometric paradigm has led some researchers (e.g., Otway and Tomas 1982) to conclude that the underlying dimensions are, in effect, little more than a reflection of the researchers' original intuitions – thus being a product of an essentially 'top-down' approach.

Fourth, Sjoberg (2000a: 5) argues that "the widespread credibility that the [psychometric] model enjoys seems to be based largely on the fact that analysis was done on averages rather than raw data, i.e., correlations reported were based on [population] means and therefore very high, thereby giving an impression that virtually all of risk perception was accounted for". That is, the psychometric model's traditional three factors or explanatory scales (i.e., New-Old, Dread, and Number of Exposed) explain only a modest share of the variance in individual risk rating or ranking. Thus, there is a

danger of under representing the spectrum of perceptions of risk (Gardner and Gould 1989).

Fifth, extrapolation of findings to the population as a whole is difficult because respondents in psychometric studies are predominately university students (Slovic et al. 1980; Johnson and Tversky 1984; Teigen et al. 1988; Brun 1992; Brun 1995). This criticism is particularly important for researchers wishing to apply the psychometric framework in developing country contexts. What is unclear from the literature is whether the dimensions and characteristics of this paradigm are culturally transferable, and perhaps more to the point, whether the psychometric paradigm operates across cultures (i.e., do all cultures view risks as bundles of attributes?). These questions will be addressed when more risk perception research applies this approach in developing countries.

3.1.2.3. Conclusion

Despite these criticisms, Slovic et al. (1986) have argued that although the specific details and factor structure have varied across psychometric studies, the overall outcome has been that perceived risk is both quantifiable and predictable. Fischhoff (1990: 230) indicates that psychometric "studies of how hazards are viewed in terms of more qualitative risk characteristics proved an opportunity to capture lay conceptions of risk, but are also useful in that they provide an insight into the lay person's general reactions towards hazards and hazard management". Unfortunately, policy makers and technocrats at times have tended to misinterpret the findings of psychometric research to confirm their beliefs that the general public is mostly ignorant and irrational with respect

to risk issues (Weyman et al. 1998; Fischhoff 1998), thus supporting a technological rationality of risk.

3.1.3. Value Expectancy Models

The psychometric paradigm has offered a useful framework for conceptualizing public and collective attitudes towards risks (Slovic 1992). However, according to Langford et al. (2000a), this approach has not focused on the individual's cognitive processes that determine her/his perception of risk. Thus an attempt has been made to develop a *cognitive model* for understanding an individual's perception of risks, particularly health risks from environmental hazards, based on cognitive and social psychology (Langford and McDonald 1997; Langford et al. 2000a). Therefore, this dissertation draws on concepts from both the Health Belief Model (HBM) and the Cognitive Social Psychological Model (CSPM).

Within the field of health behavior, several theoretical models have been developed to explain why people do not engage in various health enhancing and medically beneficial activities (e.g., wearing seat belts, using vaccinations, practicing safe sex, not smoking). The most influential models are the **theory of reasoned action** (Fishbein and Ajzen 1975), the **theory of planned behavior** (Ajzen 1991), and the **health belief model** (Janz and Becker 1984). The first two of these models are incorporated in the Cognitive Social Psychology Model. All three models share a common foundation in *subjective expected utility theory*[16], that is, the assumption that subjective cost benefit analysis influences health deliberations and resulting behaviors. According to Weyman et al. (1998: 13), "The majority of value expectancy models relate

[16] Subjective expected utility theory is founded upon the economic notion that rational behavior is based on maximizing personal benefit from actions taken.

to health behavior and have their underpinnings in behavioral decision theory (discussed under the Cognitive Social Psychology Model below), possessing the common assumption that risk behaviors reflect a conscious decision process, where outcome alternatives are evaluated in terms of their utility (relative benefit)". Although there is considerable overlap in the models, for the purposes of this dissertation, only the **Health Belief Model** and the Cognitive Social Psychological Model (CSPM) are discussed in detail. The health belief model is an older model than CSPM and provides different insights valuable for understanding the pesticide risk perceptions of South African farm workers.

3.1.3.1. Health Belief Model

In assessing the effectiveness of pesticide labels as a risk communication tool for preventing pesticide poisonings, the question needing to be asked is what is the juncture that links knowledge (i.e., risk information communicated) and action (i.e., precautionary behavior)? Researchers have argued that this juncture is perception of individual risk (Janz and Becker 1984; Ajzen and Fishein 1980; Prohaska et al. 1990). Perception of risk is a key determinant in the Health Belief Model (HBM). This model proposes that emotion (e.g., self-efficacy, self-esteem) may have a mediating effect on risk perception; however, there is limited examination in this model of the mechanisms behind emotion (Sobo 1995).

The HBM is a conceptual framework designed for explaining and predicting preventative health behaviors (often used in AIDs risk reduction programs), which was developed in the 1950's by Godfrey Hochbaum, Stephen Kegels, and Irwin Rosenstock. It seeks to identify the factors that affect the "conscious" decision-making processes.

This model attempts to explain and predict health-related behaviors by focusing on certain attitude and belief patterns (i.e., emotions) of individuals. The HBM states that the adoption of precautionary health behavior is influenced by six factors (Weinstein and Nicholich 1993; Weyman et al. 1998). These factors or concepts are (see Table 3):

1) ***perceived vulnerability/susceptibility*** - motivation is dependent upon perceived likelihood of such an event occurring (i.e., perception of risk);
2) ***perceived severity of health risk*** - individual action to influence an anticipated outcome depends upon the perceived seriousness of the consequences (also perception of risk);
3) ***perceived benefit of precautionary action*** - motivation for self-protective behavior arises from anticipating negative consequences, desiring to minimize these outcomes, and believing that it is possible to minimize the outcomes;
4) ***perceived barriers to precautionary action*** - the expected benefits of a particular action are weighed against the costs of taking the self protective action (i.e., perceptions of cost and benefits);
5) ***health information sources/risk knowledge or cues to action*** - behavior adoption is highest where knowledge of risk is largely accurate and events can motivate people to take action; and
6) ***self-efficacy*** – the belief in being able to successfully execute the behavior required to produce the desired outcomes (i.e., perceptions of self).

The Health Belief Model has been used in studies assessing farm workers' pesticide safety behaviors because of the model's acclaimed simplicity and parsimony. In these studies, the focus has been on behavior as a function of a person's subjective value of an outcome and his/her expectation that a particular health behavior will affect the likelihood of that outcome (Arcury 2002; see concepts 3 and 6 in Table 3) -- for example, whether a farm worker uses protective clothing when working with pesticides or not.

TABLE 3: Six Key Concepts of the Health Belief Model

Concept	Definition	Application
Perceived Susceptibility	One's opinion of chances of getting a condition	Define population(s) at risk, risk levels. Personalise risk based on a person's features or behaviour. Heighten perceived susceptibility if too low
Perceived Severity	One's opinion of how serious a condition and its sequelae are	Specify consequences of the risk and the condition
Perceived Benefits	One's opinion of the efficacy of the advised action to reduce risk or seriousness of impact	Define action to take: how, where, when; clarify the positive effects to be expected
Perceived Barriers	One's opinion of the tangible and psychological costs of the advised action	Identify and reduce barriers through reassurance, incentives, assistance
Cues to Action	Strategies to activate 'readiness'	Provide how-to information, promote awareness, reminders
Self-Efficacy	Confidence in one's ability to take action	Provide training, guidance in performing action

Source: The Communication Initiative – Health Belief Model, http://www.comminit.com/ctheories/sld-2929.html; National Cancer Institute (1997) *Theory at a Glance: A Guide for Health Promotion Practice.* National Institutes of Health, National Cancer Institute.

3.1.3.1.a Criticisms of the Health Belief Model

Primary criticisms of the health belief model (and indeed of all value expectancy models) are that the models tend to focus on individual attitudes and behavior in relation to a personal risk (e.g., wearing a seat belt, wearing protective clothing), and that when the risk is within a social context where social and group influences exist (e.g., living next to a hazardous waste dump and using water from the consequently polluted river, working for a farm owner who will not provide protective clothing), only "modest" associations between perceived risk and precautionary behavior exist. The question is: how well do the six HBM factors in Table 3 explain perceptions of the range of risks? "The main difficulty with this kind of approach can be succinctly stated: theories of risk behaviour which conceptualise risk behaviour as volitional and individual acts are inappropriate where risk behaviour involves two parties or more; that is, where there are

social and group effects" (Bloor 1995). Although some studies have attempted to take into account social constraints on behavior (e.g., Weyman et al. 1998), what is problematical is the attempt to insert a social element onto a model which essentially is based on individual decision-making and uses attitude methods, and where the dependent variable is limited to past behaviors and/or behaviour intentions. Thus this model does not have a mechanism for assessing the role and influence of power (e.g., authority influences), institutional processes and social structures on individual behaviour decision-making processes. That is, the health belief model views the individual as perceiving risk in a vacuum ignoring the formal and informal structures within which the individual exists.

3.1.3.2. Cognitive Social Psychological Model

The Cognitive Social Psychological Model (CSPM) builds on concepts from the **Theory of Planned Behavior** (Fishbein and Azjen 1975) and **Social Learning Theory** (Rotter 1954). The Theory of Planned Behavior (commonly used for understanding behavior to do with health risks) theorizes that behavior decisions are made indirectly based on the relationship between a range of factors and the intention to behave in a particular way (Langford et al. 2000a). These factors are:

> *Attitude* –the belief (i.e., expectation) a person has that an incident will occur and the importance (i.e., value) placed on this belief.
>
> *Subjective norm* –an individual is exposed to social pressure to conform to particular attitudes or behaviors.
>
> *Perceived behavioral control* — in risk circumstances, a person has general beliefs of control and power with respect to the self and society.

Social learning theory focuses on expectations and values associated with risks. This theory emphasizes the concept of "locus of control" (i.e., whether control of a situation is perceived to lie internally within the individual or externally with other people; Rotter 1966).

The CSPM, in an attempt to understand risk perception, also (Kown and Oei 1994) draws on an analysis of the difference between:

- *cognitive schema* – structures seen as core beliefs about the self and the world which remain constant over time, that is, "attitudinal certainties" deeply engrained into an individual's belief system and often maintained by new information collected (Eiser 1994), and
- *surface cognitive products* – attitudes or reactions at the surface of consciousness which are seen as cognitive, affective or physical manifestations (Langford and McDonald 1997).

According to Langford et al. (2000a), *cognitive products* within the cognitive social psychology model of risk perception are the individual's attitudes towards self, society and the environment in relation to a particular risk issue. These attitudes are further divided into three main sections: self-efficacy, behavioral expectations, and an importance value given to a risk (see Figure 4). *Self-efficacy* refers to the attitude an individual has in regard to his/her ability to control (or not control) a risk issue. *Behavioral expectations* relate to the individual's behavior in relation to the risk (e.g., wearing or not wearing protective clothing when using a pesticide), as well as the individual's expectations of society's or an institution's response to a risk issue (e.g., that protective clothing will be provided by the employer). *Importance value* has to do with the interest an individual has in a particular risk and whether it is important to them personally and/or to society as a whole (e.g., whether a pesticide poisoning has affected the individual; whether pesticides are a political issue). These three factors are basically

the three factors of attitude, subjective norm and perceived behavioral control stated above from the Theory of Planned Behavior.

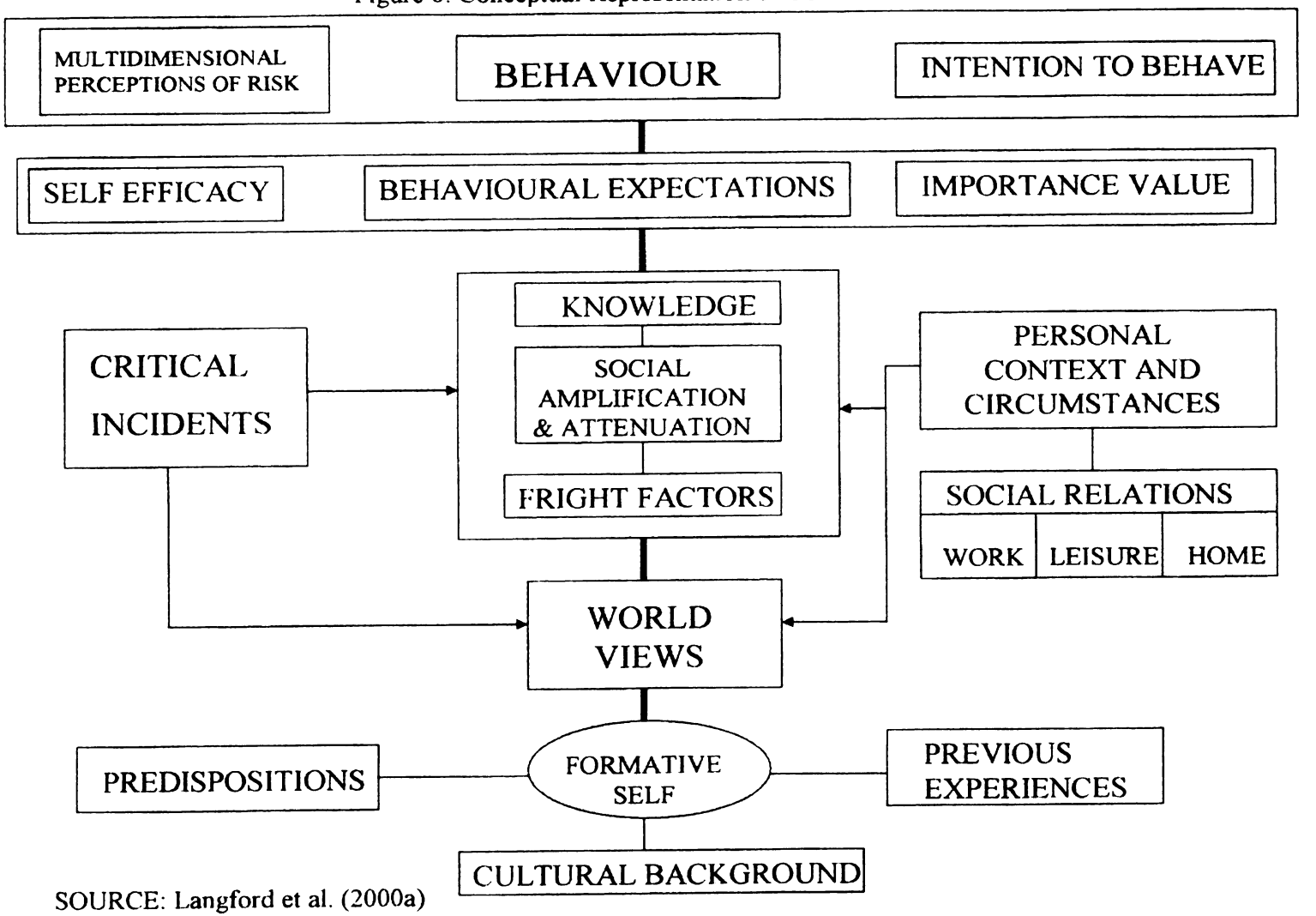
Risk perceptions are not static but instead change over time as new information is gathered or received. Attitudes influencing perception are seen to go through three main stages: *development* of attitude through external stimuli and cognitive structures, *maintenance* of attitudes through receiving new information, and *transition* from one attitude to another through exposure to new events (Langford et al. 1999).

Figure 6 is "a conceptual representation of pathways linking deeper cognitive structures to surface products, and statements of risk perception and preference, integrating the theories [outlined above] to provide a structure which can be empirically tested and potentially provide useful information for policy makers" (Langford et al., 2000a). The main components of the CSPM of individuals' risk attitudes (i.e., perception), outlined in Figure 6, are described in more detail below:

Worldviews encompass stable cognitive schema based on the formative self (i.e., genetic disposition and early development/experiences), as well as cultural background, personality, attitudes and individual behaviors (Langford et al. 2000a; Olsen et al. 1992).

However, according to Rayner (1992), these are difficult to determine, can be altered over time, and are influenced by many varying circumstances. Langford et al. (2000b), in their study on perceptions of sewage in bathing water, assessed respondents' worldviews through documenting the respondent's views of what constituted nature (i.e., their "myths of nature" [Thompson et al. 1990; cf. Merchant 2003]).

Figure 6: Conceptual Representation of CSPM



SOURCE: Langford et al. (2000a)

Personal contexts and circumstances are seen as "the present world the individual lives and works in both geographically and socio-economically" (Langford 2000a).

Socially, these incorporate factors such as occupation (e.g., farm workers), life style (e.g., living in substandard conditions in close proximity to other farm workers, alcohol addiction, domestic violence), life-stage (e.g., having children, aged) and social relations patterns (e.g., group membership). As Teigen et al. (1988) explain, risk interpretations have interpersonal variation because individuals both live in different risk environments and perceive their environments differently. For the individual, personal history and experience with hazards will play a vital role in influencing perception and thus causing variation in perception from one individual to the next. For example, the long-time farm worker who has worked with pesticides for years and perhaps experienced a poisoning incident will formulate a different concept of pesticide "risk" exposure than the long-time farm worker who has never experienced a poisoning incident or the town desk job worker who has no experience of farm work.

Critical incidents, either experienced personally (e.g., being poisoned, being made sick) or received as information (e.g., from family, friends, work colleagues who experience a poisoning), can fundamentally alter the perception of risk for an individual (Georgiou et al. 1998; Langford et al. 2000a). Accumulation of information about a risk or exposure to hazards can potentiate a change in a belief about technological hazards that will later be triggered by a particular incident.

Although the CSP Model is a relatively new approach to describing risk perception, it appears to be useful in describing different associations between varying sets of variables used by individuals in constructing risk perceptions (Langford et al.

2000a; see Figure 6). The CSPM has shown that, in addition to information on personal characteristics, knowledge and experience, "general views about the environment, as well as attitudinal variables concerning self efficacy, behavioural expectations and importance values are important in determining risk perception" (ibid: 34). For this dissertation, the CSPM provides insights into the cognitive processes of farm workers in formulating their views and attitudes towards risks associated with pesticide use and pesticide exposure.

3.1.3.2.a Criticisms of the CSPM

As stated above, the Cognitive Social Psychological Model attempts to predict individual perceptions of risk by focusing on the individual's cognitive processes which determine perceptions of risk. However, a criticism is that by mixing the disciplines of cognitive psychology and social psychology, that practically, only one of the disciplines dominates.

Another criticism of the CSP model is that it is largely conceptual and in practice not all the variables in the model can be analyzed simultaneously. Although the model is meant to be a predictor of behaviour, only "modest" associations between perceived risk and precautionary behavior exist.

3.1.4. Cultural Theory

To date, the psychometric model still leads as the dominant framework of analysis for assessing and understanding risk perception, with cultural theory the second major approach. Mary Douglas's anthropological work (1966, 1970, 1985 and 1992), and in particular Douglas and Wildavsky's (1982) work, laid the foundation for the development of the cultural theory of risk perception that challenged the previous orthodoxy of

psychological approaches to risk perception. The foundation of Douglas' earlier work, and the work of those using this framework (e.g., Thompson et al. 1990), centers on the issue of why different cultures choose different risks as their focal point (Krimsky and Golding 1992). Their work focused on understanding cultural perceptions of risk within the context of the social and institutional influences on these perceptions; their approach was operationalized for quantitative study by Dake (1991). These works are extensively referred to as being instrumental in focusing research on socio-cultural influences (e.g., societal history, social experience with hazards) as explanations of what previous models had considered to be "bias" in individuals' perceptions of risk, especially in regard to environmental and public health concerns.

An essential assertion in the cultural theory approach to risk perception is that "human attitudes towards risk and danger are not homogeneous but vary systematically according to cultural biases" (Pidgeon et al. 1992). According to Douglas (1982), "cultural bias" is defined as the attitudes, values, and beliefs (i.e., world views or cosmologies) shared by a group. Cultural bias is thus seen to influence the risks that groups decide to identify, in a manner that had not previously been explained by psychology's focus on individuals or by biophysical science's analysis of "objective" risks. "Cultural theory describes forms of social solidarity that shape worldviews and influence judgments about fairness, trust and accountability. It argues that people will react to risks in accordance with the way society is perceived and the legitimacy that they ascribe to institutions and rules of procedure" (Langford et al. 2000b: 692).

A central concept employed in the cultural interpretations of risk and the study of differences in risk perception is the grid group approach. That is, cultural theory divides

society into two main domains -- *"group" and "grid"*. "Group" refers to the influences on an individual from social relationships/interactions (e.g., socially respected peers), whereas "grid" refers to the cultural expectations or rules that are imposed on an individual (Bennett et al. 1999). An individual's cultural bias is thus linked with the extent to which there is incorporation into bounded groups ("group") and the extent to which the interactions of social life are carried out in accordance with cultural rules ("grid"). In cultural theory group and grid are always present in relation to one another, but in varying intensity (e.g., high grid and high group, low grid and high group). By linking group and grid, cultural theorists (Douglas and Wildwsky 1982; Dake 1991) identified four predominant cultural biases (or cosmologies), namely:

- hierarchists *(high grid/high group);*
- egalitarians *(low grid/high group);*
- fatalists *(high grid/low group); and*
- individualists *(low grid/low group)*

Some cultural theorists add a fifth category, that is, autonomists (hermits – Douglas 1982). Although not often referred to in the literature, the assumption is that this fifth category would have no grid and no group, but are instead autonomists because of their reactions to grid and group.

According to Langford et al. (1999: 41-42):

> *Fatalists* may feel bonded to a larger whole, but do not operate as a distinctive group. *Individualists* dislike both bonding and grouping; whereas *Hierarchists* accept the disadvantages of close bonding and grouping. *Egalitarians* on the other hand seek association with each other, but reject any sense of being circumscribed by a higher social order.

This social structure typology presents identifiable 'worldviews' or social orientations, which are meant to explain why there is variation between people's perception of risk and to categorize general attitudes to risk. According to Sjöberg (2000a: 5), the types of people (cultural groups; listed above) "choose" to be "concerned with different types of hazards. That is,

- *Egalitarians*: technology and the environment
- *Individualists*: war and other threats to the markets
- *Hierarchists*: law and order
- *Fatalists:* with none of the above".[17]

According to cultural theory, selective attention to risks is best understood through socially variable combinations of these two linked domains: cultural biases and social relations. However, cultural theory does not specify the nature of the relationship between these two domains. *Social relations* are defined as the social context which is governing a person's beliefs. These combinations or intersections of these two domains are described as constituting 'ways of life' and thus, according to cultural theorists, as offering distinctive influences on what constitutes a hazard and what does not (Weyman et al. 1998). For example, "those risks selected for worry or dismissal are said to be functional, in the sense that they strengthen one of these ways of life [i.e. social relations and cultural bias] and weaken the others" (Dake 1991: 65).

For risk perception, the main point of the cultural theory approach is that a person's action is considered 'culturally rational' if it supports that person's way of life and if it conforms to the expectations of that person's culture. Therefore, Douglas and

[17] Sjöberg does not refer to Douglas' hermit category. Perhaps the hermit would be concerned with all of the other four categories.

Wildavsky (1982) imply that individuals do not pay attention to risks merely to protect their health and safety, but may also do so as a means of conveying broader socio-political interests and agendas that are set by the culture in which the person is situated.

Cultural theorists have argued that the concept of risk (what people mean by the term "risk") is "plastic and variable" (Pidgeon et al. 1992). Douglas (1990) challenged the definition of risk as the probability of loses and gains, stating it just meant danger.

> The modern risk concept, parsed now as danger, is invoked to protect individuals against encroachments of others. It is part of the system of thought that upholds the type of individualist culture which sustains an expanding industrial system (Douglas 1990: 7).

The strength of cultural theory has been its ability to explain how risks are understood in terms of plural constructions of meanings that are culturally framed (Gabe 1995). A valuable function of this approach has been its contribution to the recognition by experts and policy makers of the divergent value systems in risk assessment (Stirling 1998).

Another contribution of cultural theory has been the reframing of differences between lay and expert views of risk as a cultural bias of the scientific community itself rather than seeing only the lay views as biased. Empirical findings by Wynne (1992), based on cultural theory, have drawn attention to the differences that exist between lay and expert frames of reference in risk appraisal. "What is taken by technical experts and policy makers to be an irrational rejection of scientific information may instead be a rejection [on the part of the lay populace] of naïve assumptions about an ideal world, both social and material, which is embedded in the 'expert' model of risk taking" (Wynne 1992: 32). Johnson and Covello (1987) proposed that there are strong social and cultural

influences which could play an important role for both lay and expert groups. Jasanoff (1986) indicates that expert risk perceptions are affected by cultural predispositions, such as institutional values, and constrained by the boundaries of 'normal' science.

3.1.4.1. Criticisms of Cultural Theory

Even though the grid-group cultural theory has made a significant contribution to risk perception research, criticisms exist. First, Johnson (1987) claims that this approach has a problem in unambiguously classifying social units that exist in terms of the grid and group dimensions. He believes that the approach's classification of cultural types may oversimplify more complex shades of social difference (Pidgeon et al. 1992). For example, environmentalism may not be only an egalitarian movement because "different kinds of environmentalism can stem from all four posited social structures" (Johnson 1987: 160).

A second criticism claims that cultural theory is fundamentally Durkheimian and static, requiring more explicit recognition of the dynamic aspects of social life (Bellaby 1990). That is, cultural theory fails to explain social process and more specifically, why individuals will possibly move from one "risk culture" to another (i.e., cultural theory fails to capture how people's cultural worldviews may change over time; Bellaby 1990; Pidgeon 1996).

However, as Pidgeon et al. (1992: 114) point out:

> The cultural theory approach has identified some very important aspects of the social fabric (Short 1984) for the understanding of risk perception and tolerance . . . the issues that it has raised are crucial for the future of the field, as well as for the issues of risk management...

3.1.5. Themes and Issues

This section presents three themes and issues concerning risk perception which cut across the four approaches discussed above -- cross cultural risk perception, multiple risk perspectives, and gender and risk perception.

3.1.5.1. Risk Perception Cross-Culturally

Perceptions of risks associated with the properties of hazards are not necessarily cross-culturally transferable (Sjöberg 1998). For example, some psychometric studies (Slovic et al. 1980; 1982; 1984 and Fischhoff et al. 1978) revealed that products such as pesticides scored fairly high on the 'dread' dimension (represented by 'perceived lack of control', 'threat' and 'seriousness of consequences') and the 'unknown' dimension (represented as 'non-observable', 'novel', and 'delayed negative consequences'). However, pesticides in South Africa appear to weigh relatively low on the dread factor for the general public. This appears to be because of the lack of awareness of the health effects and symptoms resulting from exposure to pesticides, limited knowledge of the causal connections between health effects and pesticides, and the political tolerance to pesticide risks, as well as the existing culture of pesticide use (Rother and London 1998). What is not clear is if the underlying frameworks for analyzing risk perception are cross-culturally transferable, and only the evaluations and outcomes of a specific risk evaluated within the framework vary, or whether the risk perception frameworks themselves are not cross-culturally transferable. At present not enough research findings in varied cultural contexts, such as those in developing countries, are available to answer these questions beyond speculation.

3.1.5.2. Multiple Risk Perspectives

Within the field of risk perception, there are multiple perspectives on risk. Perhaps the greatest contrast in varying perceptions of risk is between the "experts" (biophysical scientist professionals; technological rationality) and laypersons (cultural rationality). This is not to say that laypersons do not sometimes adopt technological rationality, but that in general the two groups differ in this way. Although numerous different definitions of risk have been proposed over the years, according to Weyman et al. (1998), a common theme has been the notion of mathematical probability (likelihood of occurrence), frequently coupled with some 'objective' measure of severity supported by the technical sciences. At the same time, there has historically been a desire to differentiate between objective and subjective risk. Compared to objective risk, subjective risk is referred to as the psychological dimensions (e.g., attitudes, beliefs) linked to perceived danger (Weyman et al. 1998). Social science research often accepts this dichotomy (i.e., the dual nature of risk; see Chapter One). Jasanoff (1998) highlights that there exists a socially constructed boundary between technology and society leading to the widespread belief that technological experts present the objective, unbiased facts about hazards to the unknowing, ignorant lay public. Much of national and international policy and legislation is based on and incorporates this view through embracing the risk assessments of technological "experts" as objective facts. However, over the years in developed countries, public reaction to risks has begun to influence policy making (Sjoberg 1999). As Jasanoff (1998: 174) puts it, "standards are not simply technical measures, but negotiated forms of social understanding". However, in developing countries where, because of economic interests, technological risk is in a general sense

tolerated (the voices of dissent are few), technological risk assessments presented to the public continue to be accepted as "expert" proof of safety.

The psychometric paradigm and the Health Belief Model tend to have a more technological rationality approach to individual risk perceptions where the knowledge of the expert is given more weight than the perception of the lay person. On the other hand, Cultural Theory and the CSPM tend to place more value on the perceptions of the individual without gauging these in relation to expert views.

3.1.5.3. Risk Perceptions and Gender

Within the field of risk perception, some research has been conducted around gender differences in perceptions of technological risks (Davidson and Freudenburg 1996). In this research, women tend to give higher risk ratings than men; thus women are seen as expressing a greater sensitivity to and lower tolerance of risk (Sjöberg 1998; Hitchcock 2001). Much research on gender differences in risk perception has been conducted in developed countries where gender differences occur in relation to risks that are more specific to developed country contexts (e.g., threat of nuclear war, exposure to radon; Bord and O'Connor 1997). Many conclusions drawn about gender differences in risk perception have been based on studies conducted with white women living in environments without obvious stress inducers (e.g., living next to a polluting factory or nuclear plant or a mine; Hitchcock 2001).

What is not clear is if gendered perceptions of technological risks in developing countries and especially in rural areas where access to information is limited are the same as those in developed countries. Hitchcock (2001) rightly concludes that more risk perception research needs to be conducted incorporating 'qualitative' gender differences

in perceptions, as well as wider representation of research subjects' demographic and socio-cultural backgrounds.

3.1.6. Summary

This review of the risk perception literature has highlighted the historical evolution of risk perception theories, frameworks, approaches and methodologies, as well as the concepts and tools used. Although risk perception theories and methods are fragmented, sometimes lacking in empirical support and contestable, they provide frameworks for the analysis of the content, formation, and effects of risk perception. The point of agreement among social scientists researching risk perception seems to be that no one theory has managed to offer a full explanation of risk perception and the factors driving these perceptions. However, the existing literature does present varying strategies for conceptualizing, analyzing and measuring risk perception, along with approaches to understanding the causes and consequences of risk perception. For this research project, in order to evaluate the effectiveness of pesticide labels as a hazard communication tool and the role pesticide risk perceptions play in the efficacy of the labels, relevant concepts and approaches discussed above were synthesized to inform the development of the survey instrument and the analysis of the data. This synthesizing drew on the psychometric approach, the cognitive social psychological model, the health belief model and cultural theory. Although the latter two models draw on the former two, the idea was to incorporate concepts not clearly addressed in the latter two models. More specifically, this research incorporates concepts from the above approaches such as: risk, trust, gender variation, perceived vulnerability, perceived severity of health risk, perceived benefit of precautionary behavior, risk knowledge, and cultural contexts of

risk. The findings of this research inform the viability of using and applying these concepts in a developing country context amongst a target group working where they are exposed involuntarily to the health risks associated with pesticides.

3.2. RISK COMMUNICATION

The notion of "risk communication", according to Rohrmann, refers to "a social process by which people become informed about hazards, are influenced towards behavioural change and can participate in decision-making about risk issues" (2000: 2). This social process and the reasons for engaging in it vary in relation to those social actors designing and administering the risk communication strategies, as well as those social actors seeking information or participating in decision-making. Within the risk communication literature there appear to be three schools of thought of how risk communication can control risk -- (1) risk communication as public relations (i.e., everything is safe; see section 3.2.2), (2) risk communication as a business strategy (i.e., transferring liability to end users; risk sharing; see section 3.2.3), and (3) risk communication as risk management (i.e., eliciting safety behaviors; see section 3.2.4). Within each of these schools of thought the objectives and goal of the risk communication vary, overlap and sometimes even conflict with the other schools of thought; that is, the term risk communication has different connotations and different outcomes for the various risk communication practitioners and participants. For example, the view that risk communication is a business strategy (2) would focus on corporate profits rather than the promotion of human health, which would be the focus in risk communication as a risk management strategy (3).

Risk communication research has emerged from several interrelated factors, including the legal and/or moral obligations placed on governments and industry to inform potentially exposed populations of environmental, technological and health hazards; as well as public policy dilemmas rising from social conflicts over risks (e.g., siting of hazardous facilities; The Royal Society 1992; Krimsky and Plough 1988). Baruch Fischhoff (1995), a leading psychologist and researcher in the field of decision-making, designed an eight-stage chronology summarizing the overall development of risk communication over the past 20 years. According to Fischhoff (1998b), each stage is characterized by the main communications strategy practitioners in the three schools felt was effective and reflects what was learnt about the limits of previous strategies. Thus, each stage builds on the former, without replacing that stage. Fischhoff's stages in risk communication (see Figure 7) vary from content-oriented risk communication intended to persuade (i.e., traditional authoritarian risk communication based on technological rationality), to process-oriented risk communication incorporating partnership (i.e., risk communication based on cultural rationality; Chess 2001).

Based on my review of risk communication within the Southern African region (Rother, unpublished research 2000; Johan Vermeulen, AVCASA consultant personal communication 2003), many developing countries' level of risk communication is stuck at the first of Fischhoff's stages of evolution. That is, risk communication is viewed from the traditional authoritarian standpoint where the "ignorant" populace does not understand or is not exposed to the technical scientific data that is supposed to ensure the outcome of appropriate risk behavior (Sandman 1989). With large populations in Southern Africa that are illiterate or have had limited exposure to formal education, this

Figure 7: Fischhoff's (1995) Developmental Stages in Risk Communication

1. All we have to do is get the numbers right.
2. All we have to do is tell them the numbers.
3. All we have to do is explain what we mean by the numbers.
4. All we have to do is show them that they have accepted similar risks in the past.
5. All we have to do is show them it is a good deal for them.
6. All we have to do is treat them nice.
7. All we have to do is make them partners.
8. All of the above

Source: Fischhoff 1995; Chess 2001

assumption would appear to be logical. However, this becomes an argument for not incorporating stakeholders and target groups in democratic risk communication (i.e., risk decision-making) processes and for maintaining the present top-down approach to risk communication in developing countries like South Africa.

For the purpose of evaluating the effectiveness of pesticide labels as a risk communication tool for South African farm workers this section briefly discusses four factors that need to be considered when communicating risks, as well as the three schools of thought concerning risk communication. However, the main focus of this section and the dissertation is the use of pesticide labels as risk communication tools for risk management. Within the context of risk communication as risk management, two approaches for analyzing this dissertation's findings are discussed -- the mental models approach and the social amplification of risk.

3.2.1. Risk Communication Factors

When communicating risks to the public, there are several factors that need to be considered which influence both how the information is communicated and how it is received. These factors are: the target audience; the messenger; the message itself; and the medium for transferring the message. Fessenden-Raden et al. (1987: 100) stated that,

> No matter how accurate it is, risk information may be misperceived or rejected if those who give information are unaware of the complex, interactive nature of risk communication and the various factors affecting the reception of the risk message.

Below is a brief discussion of the characteristics of each of these four factors.

3.2.1.1. The Audience

All approaches to risk communication make assumptions about the audience (i.e., receiver factor; e.g., uniformed, passive, credulous, decision-makers; see Figure 7), however some approaches are more sophistical and others more empirical in developing those assumptions. Nevertheless, "knowing the audience" appears to be the most important principle for effective risk communication (Baxter and Eyles 1997).

> Typical findings are that success of any communication depends upon the characteristics of the sender of the message, and the receiver. For risk communication research, a clear conclusion to be drawn from this work is that if the message is not appropriately matched to the frame of reference of the audience then the communication may fail (or even prove to be counterproductive; Pidgeon et al. 1992: 178).

The following characteristics are some of those which need to be taken into consideration when conducting an analysis of the audience (Fassenden-Raden et al. 1997; Baxter and Eyles 1997):

- The individual's or collective's (e.g., community, workers) values and world views (e.g., preservation of nature);
- Level of past experiences with the risk (e.g., Has any one been poisoned before?);
- Previous experience with the communicating organization (i.e., attitudes towards the communicating organization or the organization responsible for the risk);
- Reading level of the target audience;
- Educational level of the target audience;
- Current level of knowledge about the risk (e.g., to what extent is the individual/community knowledgeable about the risk?; risk perceptions);
- Health of the individual and family members (e.g., has the individual, or a member of his or her family, suffered from health problems that individuals may attribute to the risk?); and
- Local conditions (e.g., what else is happening in the community that might affect how the information is received?).

Audiences are not homogeneous and in order for risk communications to be effective and successful, audience characteristics have to be calculated into the risk communication strategy (e.g., more than one risk communication strategy/message may have to be used).

3.2.1.2. The Messenger

Messenger characteristics (i.e., source factor) are also an influencing factor on risk communication. Potentially, there may be multiple messengers providing risk information to target audiences. Messengers are often viewed as "official" messengers (e.g., government agencies, chemical companies) or "unofficial" messengers (e.g., friends, neighbors, activist groups, media; Fessenden-Raden et al. 1997). Trust of the messenger on part of the audience plays a vital role in whether the message being communicated will be accepted or not. That is, the credibility of the messenger is judged by the audience. The importance of trust in the messenger for risk communication is discussed further on in this section.

3.2.1.3. The Message

Risk messages within the three schools of thought of risk communication use either one or both of two mechanisms to achieve their goals – informing and influencing. However, these mechanisms are not mutually exclusive and coexist in risk messages, sometimes even appearing in a single risk message.

As noted above, there are "official" risk messages and "unofficial" risk messages (Fessenden-Raden et al. 1997). Official risk messages are those statements communicated by the "experts", for example, scientists, government officials, chemical companies' technical staff; whereas, unofficial risk messages are referred to as statements communicated by laypersons and mass media. There are times when the content of the risk messages from these two groups conflicts with one another causing confusion for the target audience(s). In general, risk messages are hard to formulate in ways that are accurate, comprehensible, and not misleading (National Academy of Sciences 1989). According to Fischhoff et al. (1995), risk messages tend to make sweeping general statements rather than offering numerical information/statistics regarding the magnitude of the risk. Risk messages are often controversial because the hazards they describe are themselves controversial (i.e., the experts draw varying conclusions about the hazards). "Experts are frequently accused of hiding their subjective preferences behind technical jargon and complex, co-called objective analysis" (National Academy of Sciences 1989: 2).

According the National Academy of Sciences (1989: 11) risk messages should have the following traits for effective risk communication:

1) Emphasize information relevant to any practical actions that individuals can take;

2) Be couched in clear and plain language;
3) Respect the audience and its concerns; and
4) Seek to inform the recipient, unless conditions clearly warrant the use of influencing techniques.

3.2.1.4. The Medium

Risk communication messages, developed by messengers, are transmitted to diverse target audiences through various modes of delivery, that is, mediums. The characteristics of the risk communication distribution medium (i.e., channel factor; Petty and Cacioppo 1981) are influenced by audiences culturally supported media of communication. For example, when pesticide safety training is required, some societies rely on electronic, self-taught risk communication programs, while others use theatrical presentations to communities of workers.

Pesticide labels are the pesticide industry's medium of communication that relies on technological rationality, and may not be effective amongst non-western cultures. This medium is predominately used in South Africa for communicating pesticide risks to farm workers. The South African government and pesticide industry assume that the pesticide label is a viable medium for communicating pesticide risks and does not query the appropriateness of the characteristics of the medium for the target audience – literacy, technical language proficiency, varied message interpretations of icons and symbols, and the possible failure on the part of the end user to recognize the label as a risk communication vehicle.

3.2.1.5. Summary of Risk Communication Factors

All four risk communication factors – audience, messenger, message and medium – play a crucial role in whether a risk communication strategy is effective or not and are

important components in this dissertation for the analysis of the effectiveness of the pesticide label as a risk communication tool. The four factors of risk communication described in this section will be returned to later on in this chapter under the discussions of social amplification and trust.

3.2.2. Risk Communication As Public Relations

According to L.A. Grunig (1992), public relations is "a constant process of studying what an organization, company, or industry is doing, researching the constantly changing public climate within which it is doing it, and shaping communications programs to make people understand what's going on." The emphasis in public relations is to convince the public that there is a low personal risk through "making them understand." In order to serve the public or organizational interests, James E. Grunig (public relations expert and guru) has mapped out four models of communication used by public relations practitioners. Three of these models use communication strategies that rely on a technological rationality (i.e., one-way communication; see first three models in Figure 8). The last model in Figure 8 employs a more cultural rationality to communication (i.e., two-way communication; see Chapter One). As with Fischhoff's developmental stages, Grunig's four models also reflect a move from the traditional top-down approach of communication to a more egalitarian model of engaging the public in dialog.

More recently, risk communication in developed countries, and especially the United States, has been designed and funded (predominately by government and industry) to allay public fears about societal risks, in particular "technological risks", (e.g., the United States Environmental Protection Agency regularly invites public

Figure 8: Grunig's Four Models of Public Relations

Model Name	Type of Communi-cation	Model Characteristics
Press agentry/publicity model	One-way	Uses persuasion and manipulation to influence audience to behave as the organization desires
Public Information model	One-way	Uses press releases and other one-way communication techniques to distribute organizational information. Public relations practitioner is often referred to as the "journalist in residence.
One-way asymmetrical model	One-way	Uses persuasion and manipulation to influence audience to behave as the organization desires. Does not use research to find out how the public feels about the organization.
Two-way symmetrical model	Two-way	Uses communication to negotiate with publics, resolve conflict, and promote mutual understanding and respect between the organization and its public(s).

Source: http://iml.jou.ufl.edu/projects/Fall99/Westbrook/models.htm

input/comments on pesticide legislation; Ottway and Wynne 1989; Weyman et al. 1998). This is however a strategic model, or a cooptational model, or a inauthentic model (Habermas 1984), with the goal of having key actors participating in the deliberative process so that when a result is arrived at, they may be more willing to accept it or more specifically be subject to cooptation. However, this developmental stage of risk communication has not been reached in most developing countries. As noted, above, risk communication in these countries appears to be stuck at Fischhoff's stage one. A common vehicle for communicating risk by public relations practitioners is through the media (e.g., newspapers, radio, TV; Heath and Nathan 1990-91), which fosters the one-way approach to risk communication.

3.2.2.1. Public Relations Uses of Risk Communication in the Chemical Industry

For the purpose of this dissertation, the focus is on the technological rationality use of risk communication by the chemical industry. That is, the chemical industry's one-way use of risk communication strategies to both broadcast to the public that chemicals are safe and to project their image to the public as positive and not a ruthless, profit oriented corporate giant.

According to Chess, "risk communication can be seen as an organizational adaptation of chemical manufacturers to external pressure" (2001: 179). Chess (2001) cites the 1985 Bhopal tragedy as an example of the chemical manufacturing sector using risk communication as a public relations strategy to increase their legitimacy and to tackle the incident's destabilization of their authority. Shortly after the incident, the Chemical Manufactures Association (CMA) "initiated the Community Awareness and Emergency Response Program, which encouraged CMA member corporations to work voluntarily with communities to improve emergency response and community awareness of hazardous chemicals" (Chess 2001: 181). This was a measure by industry to move down Fischhoff's developmental stages (see Figure 7) as a means of projecting the image of engaging communities in discussion. That is, moving beyond the negative public image of chemical industry dictating to the public, but instead "listening" to the public. Varying risk communication strategies were employed by the chemical manufacturers to adapt to and combat the hostile environment after the Bhopal incident, and to improve their public image. One such strategy was the CMA's Responsible Care Program (discussed in the Pesticide Regulation section in Chapter Two) which established several

codes of conduct and guidance for communicating chemical risks to communities[18] (see Chapter Two for a critique of these attempts).

3.2.3. Risk Communication As A Business Strategy

Risk communication is used as a business strategy in terms of fulfilling legislative requirements, risk sharing or liability sharing/transfer, minimising/preventing business crises and minimizing/preventing public risk conflicts (Wiedemann et al. 2003; Öncüler 2003). In many developed countries (e.g., the USA and the EU), risk communication is mandatory and legislated, requiring companies to have an active risk communication strategy and implementation plan. This is, however, not the case in most developing countries in general and South Africa specifically. For example, in South Africa, the Apartheid era supported industry's approach to secrecy and lack of information (Rother and London 1998). What can be inferred from the works by Rother, London and Burgess (2000), and London and Rother (2003) is that pesticide risk communication in South Africa is geared towards protecting the industry from liability rather than ensuring or promoting adequate safety behavior amongst end-users. That is, pesticide risk communication is predominately employed as a business strategy for protecting industry and for window dressing (e.g., the promotion of safety; see discussion of safe use programs in Chapter Two).

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[18] Prior to this initiative by the CMA and with much resistance from industry, the United States Congress passed the Emergency Planning and Community Right to Know Act. This Act was a result of unions' and environmentalists' insistence that there be a law forcing industry to communicate risks about toxic chemicals through providing communities with information about the toxic chemicals they store, produce and release into the environment (i.e., through the Toxic Release Inventory). This Act was a hallmark in legislating risk communication initiatives in the United States. However, subsequent to the September 11th terrorist attacks on the US, this Act has been suspended by the more recent US National Security Act.

For the purpose of this dissertation, the interest in risk communication as a business strategy is in the process of risk sharing or transferring liability onto the end user. As described in Chapter One, the pesticide label is a legally binding document where liability of "misuse" falls on the user. Furthermore, by communicating the potential risks of the particular pesticide on the label, the chemical company "shares" the risk with the end user.

Minimizing and preventing business crises is seen to be achieved through a company's use of "risk communication as an audit tool" (Wiedemann et al. 2003). Namely, companies answer a series of questions relating to whether company activities give rise to possible risk issues, assessing the sensitivity to risk from the company's operational environment, and evaluating the company's attitude toward risk and how the company deals with the public. The idea is the more yes answers to questions within the categories above, the higher the need for the company to engage in risk communication processes (Wiedemann et al. 2003).

Companies rely on an analysis of the two perspectives of risk, that is the "experts" and "laypersons" dichotomy (discussed in Chapter One and earlier in this chapter as one of the themes of risk perception), for minimizing and preventing public risk conflicts. How this analysis is viewed varies from company to company with views falling within any of Fischhoff's developmental stages (Figure 7) or Grunig's communication models (Figure 8). Although in developed countries, companies are attempting to be more "sensitive" toward layperson's perspectives, there is still a tendency to gauge these in relation to "expert" views (see the mental models framework below).

3.2.4. Risk Communication As Risk Management

Risk communication as risk management has evolved within the overall approach of risk analysis rather than from the field of "communications" per se. Thus the theoretical foundation for this field is not in communications theory as might be presumed, but in social psychology (i.e., the psychology of risk; Weyman et al. 1998). Similar to risk perception, risk communication as risk management has been built on the theoretical frameworks of psychologists such as Fischhoff, rather than developing its own theoretical framework. This vital area of communications has, however, a limited and focused role of supporting risk management activities. That is, the field of risk communication has been about relating (i.e., communicating) risk perceptions and risk characterizations to public policymakers and industry decision-makers, and communicating risk assessments to stakeholders, as well as developing strategies for managing risk. Risk communication has been based on the assumption that through communicating "accurate" risk information to the target audience, individuals will in turn be more able to make informed decisions about their own precautionary and risk behaviors by "knowing" the consequences of their behaviors (The Royal Society 1992; Bennett 1999; Chartier and Gabler 2001).

3.2.4.1. Theories/Approaches Used In Risk Communication as Risk Management

In critiquing the traditional risk communication premise that effective communication of risk must be based on "scientific knowledge" alone, social scientists argued that there is a need to understand the range of factors which influence both individual and group responses to risk (Pidgeon et al. 1992; Wynne 1992; Fischhoff

1995). Results from the early psychometric research, coupled with evidence from socio-cultural theorists, highlighted the differences between the expert and lay evaluation of risks and emphasized that lay perceptions reflect broader conceptualizations of risk than those adopted by scientists and technocrats (Fischhoff 1995; Walker et al. 1998). These conceptualizations are not only affected by the beliefs, attitudes and expectations of the target populations, but also include much broader social issues than just responses to the risk object itself. Two theories/approaches that are used by social scientists to broaden the analysis and discourse of risk communication beyond the public relations and business strategy uses of risk communication, and that incorporate the above issues, are the *mental models approach* and the *social amplification of risk framework.*

3.2.4.2. Mental Models Approach

3.2.4.2.a The Concept of Mental Models

The mental models approach is a commonly used psychological approach in risk communication research attempting to assess both lay (cultural rationality) and expert (technical rationality) perceptions (or *mental models*) pertaining to a certain risk for developing effective risk communication (Jungerman et al. 1988; Bostrom et al. 1992; Lazo et al. 1999; Weyman et al. 1998; Fischhoff et al. 1997; Atman et al. 1994). The mental models approach "relates to the process by which individuals manipulate internal representations of reality, in the course of thinking about, and making sense of the world around them" (Weyman et al. 1998: 10). These mental models are seen generally within psychology as "cognitive tools" for individuals to construct explanations of events and experiences. These cognitive tools include the integration of knowledge, attitudes, beliefs, impressions and images. Developed simultaneously in Europe and the United

States, this approach to risk communication attempts to highlight several of the complexities inherent in a receiver's frame of reference (Jungermann et al. 1988; Bostrom 1990; Bostrom et al. 1992). Mental models are considered to be a "psychological tool" for reducing uncertainty and complexity (MacGreggor and Fleming 1996) and are used in risk communication research to gather information on lay people's reasoning in regard to a range of hazards and risks. Risk researchers use the mental models approach in order to describe an individual's conceptual frameworks for hazards based on the premise that risk communications to lay people should provide individuals with what "they" actually need to know (Pidgeon et al. 1992). As presented by Weyman et al. (1998), the aim of employing the mental models approach in risk communication is to elicit mental content on the basis of which practitioners can develop methods for presenting information to target audiences in order that they can make informed judgements. The ambiguity that exists in this aim is the thin and highly contested line between lay people "making informed judgements" and actually making the judgements the "experts" think they should make.

Bostrom et al. (1992) explain that, "determining what people know – and need to know - about [hazards] requires quite different research strategies than the study of summary estimates", as is used in the psychometric approach. That is, there is a distinction between (1) what people know about risk (descriptive), (2) how people come to know what they know (formative), and (3) what people need to know about risk (normative). In an endeavor to move away from the top-down approach used in psychometric studies, the mental models approach attempts to gain a more detailed insight into qualitative aspects influencing perceived risk, including social influence variables.

Providing information so that the layperson can "make an informed judgement" is attempted through "fitting" risk information to the target audience's way of thinking. This approach is said to have three basic beliefs (Weyman et al. 1998: 24):

- The recipient of communicated messages needs a basic understanding of the exposure, effects, and mitigation processes relevant to making decisions about the hazard(s);
- Recipients' existing beliefs affect how they interpret and use any new information; and
- The information should be presented with an appropriate text structure, consistent with general research findings on textual comprehension.

3.2.4.2.b Application of the Mental Models Approach

To collect this qualitative information on perceived risk, researchers employing the mental models approach firstly rely on unstructured, individual interviews using techniques of "think aloud" and "free association", followed by structured interviews (Weyman et al.1998). A vital intention of this qualitative approach is "...to elicit people's beliefs that neither puts new concepts in their minds nor leaves existing ones unstated" (Bostrom et al. 1992). According to Weyman et al. (1998: 10) "this process is claimed to provide an insight into both the appropriateness and accuracy of people's risk beliefs (i.e., mental models). By the use of open-interview techniques, individual mental models of a hazard for both expert and lay subjects are solicited.

After soliciting lay perceptions of risk through the above approaches, the information is then 'mapped' onto an expert model of the particular risk. The expert model becomes the baseline for comparison with the assumption that the expert model is "accurate". 'Influence diagrams' (a pictorial technique for illustrating the important concepts and relations between concepts that an individual associates with a problem

area) and 'decision trees' (i.e., diagrammatic maps/pictures illustrating lay knowledge of hazards, listing key concepts and interlinking these concepts with expert concepts) are characteristically used by this approach to graphically illustrate the relationship between expert and lay views (Morgan et al. 2002). Researchers use this comparison of models to identify the aspects of the lay subjects' models that are "appropriate" or "inappropriate" or to identify "important concepts" that are seen as missing (Atman et al. 1994). Most studies employing this approach have focused on lay perception of risks associated with a specific substance (e.g., radon, electromagnetic fields, HIV, chemical exposures; Weyman et al. 1998). The mental models method is used in the context of individual risks; one thing that remains to be seen is if this approach is applicable to understanding the bases for perception of larger-scale societal risks (Johnson 1992).

Although studies using this approach have provided valuable insights, especially in relation to chemical risks, a criticism of the mental models approach is that it tends to present the view of lay toxicology perceptions as only deviations from the expert model. For example, one study revealed that laypeople and experts disagreed strongly on many points of toxicology, emphasizing that laypeople did not conceive of exposure as mediating between chemical releases and health effects, and that the laypersons and experts could not agree on how animal tests apply to humans (Kraus et al. 1992).

The mental models framework has also been used in informing models of how to accomplish risk communication. "Where discrepancies are apparent between lay and expert models it is suggested that these can be used to guide the format of risk communication material, the performance of which can [be] evaluated on a sample representative of the target population" (Weyman et al 1998: 11). On the surface, the

mental models framework appears to be sensitive to lay perspectives (i.e., democratic in approach); however, in reality this framework fosters the top-down approach to risk communication. The idea is that risk communication strategies be based on the findings of mental models research to bridge the gap between lay mental models and expert models by "adding missing concepts, correcting mistakes, strengthening correct beliefs and de-emphasizing peripheral ones" (Fischhoff 1997). The mental models approach does not appear to only identify content suitable for communicating, but according to Morgan et al.'s (2002) new book, the approach also offers presentation and evaluation possibilities for risk communications. However, this advice seems to be theoretical rather than based on a sufficient sample of case studies of risk communication.

Some social and cultural theorists have argued that the mental models approach takes too narrow a view of science and that it is locked into a subjective/objective dualist conceptualization of lay and expert models of risk, viewing the former with reference to the latter (Weyman et al. 1998). That is, "if lay people were trained decision analysts then it would be straightforward to determine what information they need" (Morgan et al. 1992). This seems to imply that the main ethos behind the mental models approach is in regard to educating the populace on risk. That is, risk communication strategies need merely be adapted to the needs of the receiver, and the receiver merely needs to be "educated" about risks.

The mental models approach views the task of risk communication as being educational to enhance the public's understanding of science (Wayne 1992). As stated above in the risk perception section, the mental models approach remains somewhat top-down in its approach of tailoring risk educating materials to the target audience.

3.2.4.3. Social Amplification of Risk

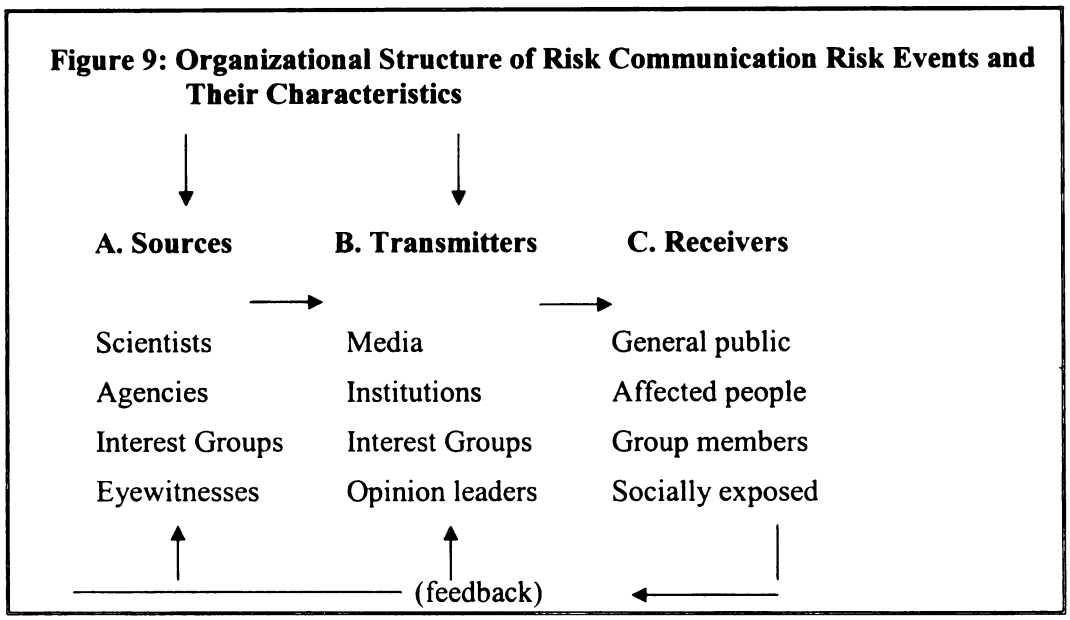
3.2.4.3.a The Concept of Social Amplification of Risk

Whereas the mental models approach focuses on the psychological aspects in risk communication, the social amplification theory of risk communication focuses on the social experience of risk. The social amplification of risk, first introduced by Kasperson et al. (1988), was intended to overcome the theoretical fragmentation in the fields of risk perception and risk communication by providing a new framework to analyze risk. The concept of social amplification of risk refers to the premise that events involving hazards interact with psychological, social, institutional and cultural processes in a manner that heightens (i.e., amplifies) or attenuates perceptions of risk which ultimately shape risk behaviour. This concept of amplification is derived from classical communication theory for relating how social agents receive, interpret and pass along different risk signals. For risk communication, "social amplification is a social analogy to communications theory, positing that people and organizations can act like amplifier stations to risk messages that will ripple through society and cause different effects; economical, judicial, social, etc." (Wahlberg 2001: 241).

According to Renn et al. (1992), in the theory of the social amplification of risk, risk is conceptualized partially as an "objective" threat of harm to people by a hazard or event (i.e., objective property) and partially as a result of social and cultural experiences (i.e., a social construct). Treating risk simultaneously as an objective property and a social construct means that at any given time it is unclear whether the term social amplification refers to information by, for example, companies, or to risk perception by individuals, or both (i.e., risk communication as a property of a system composed of

companies and individuals). In turn, this conceptualization of risk avoids the problems of total relativism on one hand and of technological determinism on the other hand (Renn et al. 1992: 140). This point emphasizes the existence of a dual nature of risk discussed in Chapter One, that is cultural rationality (i.e., relativism) and technological rationality (i.e., determinism). It also highlights the complexity of analyzing either in isolation from the other, while identifying the complexity in analyzing the interaction between the two.

Kasperson et al.'s (1988) model attempts to describe the various dynamics of the social processes which lead to differences in risk perceptions between experts and laypersons. In some cases, experts see certain hazards and events as relatively low in risk while the same hazards and events become a particular focus of concern and sociopolitical activity within a society (*risk intensification*; e.g., electromagnetic fields). In other cases, hazards perceived by experts as more serious receive comparatively less attention (*risk attenuation"*; e.g., smoking; Pidgeon et al. 1999). The social amplification model, as described by Renn (1991), views the societal organizational structure of risk communication (see Figure 9) as consisting of sources (i.e., message developers such as, scientists, pesticide industry), transmitters (i.e., messengers such as, media, pesticide labels), and receivers (i.e., the audience such as, the general public, farm workers). "The social amplification framework holds that, as a key part of that communication process, risk events and their characteristics become portrayed through various risk signals (images, signs, and symbols) which in turn interact with a wide range of psychological, social, institutional, or cultural processes in ways that intensify or attenuate perceptions of risk" (Pidgeon et al. 1999: 67-68). In this study, technical scientists from developed countries are the "source" of the message, pesticide labels are the "transmitters" (i.e.,



Source: Renn (1991) and Pidgeon et al. (1999)

messenger of risk communication) and farm workers in the Western Cape Province of South Africa are the "receivers" (i.e., the audience).

3.2.4.3.b The Process of Risk Amplification

The social amplification process begins with a risk event (see Figure 9) which can be a physical event (e.g., a chemical accident such as occurred in Bhopal) or the recognition of a potential adverse effect (e.g., neurological effects of organophosphate insecticides). The hypothesis is that individuals or groups, through their perceptions or mental schemes, select characteristics of these events (see Sources in Figure 9). They in turn communicate their interpretations of what occurred to other individuals or groups thus acting as *amplification stations* through their behavioral responses to the event. Amplification stations are represented by individuals, groups or institutions (see Transmitters in Figure 9). The actual process of receiving and processing risk

information has been well covered in the risk perception literature (Covello 1983; Slovic 1987; also see the risk perception literature review above and see Receivers in Figure 9).

Individuals, however, are also members of larger social units that codetermine the dynamics and social processing of risks (Renn et al. 1992: 141). Kasperson et al. (1988) refer to these social units as *social stations of amplification*. That is, individuals do not only follow their own frame of reference and values for interpreting and processing risk, but are also influenced by their roles as members of social groups or as employees of institutions. Thus individuals also process risk information in terms of the rules or cultural biases of the groups or organizations with which they are affiliated (i.e., the influence of technological rationality or cultural rationality; Johnson and Covello 1987). These role-specific factors and cultural biases of the group or organization are internalized by and reinforced for the individual through education and training, and identification with the goals and functions of the institution, as well as through positive rewards and negative judgments.

Kasperson et al. (1988) highlight that in the process of risk amplification there is an information flow, representing the risk or risk event, linked to the behavioral and communicative responses by individuals and social amplification stations that often leads to the generation of secondary impacts on people not directly affected by the original hazard event. For example, a secondary impact upon the original risk-managing organization might include loss of sales (e.g., through a consumer boycott or a product recall), regulatory constraints or community opposition. A third order of impacts in the social amplification process can also be achieved when secondary impacts are perceived by social groups and individuals. Thus these impacts may spread or "ripple" to other

parties, locations, or other risk arenas (Wahlberg 2001). Each category of impact will not only broadcast social and political impacts, but will also trigger (in risk amplification) or hinder (in risk attenuation) changes for risk reduction (Kasperson et al. 1988).

3.2.5. The Expert And Lay Perspective In Risk Communication

In Section 3.1 on Risk Perception, the discussion of multiple risk perspectives was introduced (see section 3.1.5.2), particularly the discussion of lay and expert perspectives of risk. As has been argued thus far, risk communication models are influenced by the framing of risks from varying perspectives. Most significant is the influence of the two main perspectives in risk communication, (1) that from the natural science by "experts", and (2) that from the general public or the "lay" perspective. A marked difference between these two perspectives is that the "experts" tend to define risk in terms of effects on populations, while the lay audience focuses on effects on individuals (Pidgeon et al. 1992). This section further discusses these two perspectives and their influence, as well as the implications, for risk communication.

3.2.5.1. Technical View of Risk Communication

Traditional risk communication of the 1970's and 1980's tasked government agencies, private companies, and scientific "experts" to provide "rational" information for raising the public's level of knowledge (Gutteling and Kuttschreuter 2002). This has become known as the 'technical view' or the "Factual Information Model" (Chartier and Gabler 2001). The underlying rationale in the technical view is that "when people are given the 'facts', their 'irrational' opinion will change, and their subjective perceptions will begin to align with scientific judgment" (ibid, 35). This technical view of risk

communication continues to be the dominant view. It embodies a rationalistic one-way, expert-to-laypersons information flow assuming that the public requires and will utilize accurate (i.e., technical, quantitative, or statistical) information and scientific know-how. Furthermore, extending this technical approach, risk communication strategies were thus assumed to be a vehicle for communicating risks, not just to inform the public, but in order to elicit behavioral changes that will reduce risk (ILO 1991). For example, pesticide hazard communication tools, such as pesticide labels, are industry's and government's method of communicating pesticide hazards with the assumption that end-users will then protect themselves from the potential health risks associated with pesticides. However, this technical approach fails at effectively communicating risk because of four faulty underlying assumptions:

1) that the lay public and the scientific community share the same analytic thinking pattern;
2) that lay people have confidence in the scientific knowledge base;
3) that risks are apolitical (i.e., risks do not occur in a socially and politically influenced context); and
4) that the target audience views reality in that same way as the expert communicator (Gutteling and Kuttschreuter 2002).

According to Weyman et al. (1998), historically a fundamental assumption amongst technocrats, industrialists and legislators was that technical activities and processes were free from substantial risk and that the public has a tendency to overreact and exaggerate risks. A controversial corollary based on this contentious assumption was that all that was needed was effective communication about health and safety in order to "educate" the public about the "true risks and benefits" and this would dispel the public's "irrational" fears. However, social and cultural theorists believe that for effective risk

communication, emphasis must be put on the broader social issues (e.g., social-economic circumstances and literacy levels of the target population, countering the assumption that risks are apolitical) rather than the risk object itself (Weyman et al. 1998).

As Morgan (1996) highlights, this traditional technical view ignores two key issues in risk communication. First, it does not have a means for systematically determining what the general public already knows about risk. Second, the traditional view does not have a systematic means of assessing the information required for people to make the risk decisions they face. The second point is particularly important for the issue of pesticide labels as a risk communication tool in developing countries.

3.2.5.2. Democratic View of Risk Communication

The "democratic" view of risk communication (i.e., involving target groups and laypersons in decision-making) elaborated by Cvetkovich et al. (1989) and Rowan (1994) is becoming the dominant view in developed countries for what is perceived to be the most effective model for risk communication. In its ideal form, this model proposes a two-way exchange of information, with rules to guarantee a just and fair process, incorporating the participation of all stakeholders in the decision-making and void of any persuasion (Chartier and Gabler 2001). The objective of the democratic view is "mutual understanding" and not "exertion of power" which dominates the technical view to risk communication (ibid, 5).

In general, risk communication in developing countries does not embrace the democratic view of risk communication and it is not clear as to whether the risk communication evolutionary process in these countries will incorporate this view. What is clear is that as long as transnational companies and domestic industries continue to

exploit developing country populations, democratic risk communication will not be strived for.

Although only limited research has been conducted on risk communication in developing countries, Huerta and Macario's (1999) work on communicating health risks to Hispanic populations does shed light on research needs to dislodge risk communication from stage two in Figure 7. Their intent is not to move through the stages described by Fischhoff (1995), but instead to create stages that take into account relevant socio-cultural factors. Their work, which draws attention to the need for including socio-cultural factors in risk communication (e.g., designing of interventions, communication channels), is more applicable to risk communication in developing countries than mainstream risk communication literature. Also highlighted in their work is that risk communication research in developed countries tends to focus on the majority population excluding other racial/ethnic populations within the society. Huerta and Macario (1999) argue that risk communication research must take into account the difference between "collectivistic" cultures (e.g., some developing country populations such as South African "Colored" population) versus "individualistic" cultures (e.g., some developed country populations such as White/Anglo populations in the US), as the cultural interpretations and responses to risk communication will vary.

While the democratic approach to risk communication may be a progressive approach, the risk communication literature, research and findings need also to reflect the socio-cultural differences between developed and developing country populations, especially as empirical data from developing countries for risk communication research is

limited. This dissertation aims to contribute risk communication as risk management insights from a developing country perspective.

3.2.6. Summary

Risk communication research in developed countries has evolved differently from that in developing countries. This evolutionary process is in part due to the difference in how risk communication is used by the chemical industry in developed and developing countries. This review of the literature on risk communication as a management strategy presented several approaches used in this dissertation for an analysis of pesticide labels as a risk communication tool. Although there are efforts to promote a more democratic approach to risk communication in developed countries, the top-down technical view still prevails in developing countries.

The risk communication literature concentrates on how to improve on risk communication by giving guidelines for two-way democratic communication, being sensitive to the receivers' frame of references and so forth. This dissertation, however, provides more of a case study of the effectiveness of a risk communication tool in a context where the ideals of two-way democratic communication are not yet espoused by powerful social actors.

3.3. RISK PERCEPTION AND RISK COMMUNICATION INTERACTION

The risk perception and risk communication literature have been presented in this chapter as separate sections. However, a central focus of this dissertation is the interaction between the two. This section, therefore, discusses important parts of the literature where risk perception and risk communication interact.

3.3.1. Perception

Perception is a significant concern for risk communication. Risk perception research (discussed in section 3.1.) has provided risk communication researchers with insights into the various issues in relation to people's attitudes, beliefs and interpretations of risk. However, most of the risk communication literature refers to risk perception from the perspective of how to use communication to control, manipulate and change perceptions in order to achieve a desired precautionary behavior. What is not discussed in the literature is the role risk perceptions play in interpretations of risk communication. This is an area that this dissertation hopes to shed some light on.

3.3.2. The Role of Trust in Risk Perception and Risk Communication

The issue of an audience's trust in the institutions and persons tasked with managing risk in a country is a point of contact between risk perception and risk communication research. Langford (2002: 102) expresses the concept of trust as a central theme in examining risk perception and risk communication in contemporary society, "with trust representing a highly complex process linked to notions of individual and social freedom and responsibility". Walker et al. (1998) argue that the issue of public trust (or more correctly, distrust) of risk management organizations is key to understanding the public's perception of risk and perception of the means through which risk is communicated to the public.

The assumption is that when individuals (i.e., the audience) lack information, knowledge, interest, time, abilities or other resources to make decisions about risk, they rely on others whom they perceive as having the resources and competence, and/or the individuals' interests at heart (e.g., scientific and technical "experts"). Thus these

individuals (i.e., audience) are viewed as trusting those in positions of power and authority without questioning what those incumbents say or do. In risk communication, this is expressed in terms of trust in the risk message and the messenger of the risk communication (see discussion of risk communication factors in Section 3.2.1).

An analysis of trust has been used in many studies on risk perception and risk communication in the USA (e.g., Slovic, Flynn and Layman 1991; Kasperson, Golding and Tuler 1992; Renn and Levine 1991). However, trust has been less used as an analytical factor for risk perception in studies outside of the USA. With respect to Sweden, Sjöberg and Drottz-Sjöberg (1994) and Sjöberg (1998) question the relevance of understanding social trust for explaining risk perception. They argue that empirical data indicates that the relationship between risk perception and trust is weak, because people feel that there is only so much that scientists and experts know (Sjöberg 2001). Margolis' (1996) **loss of trust** theory states that risk communication problems evolve mainly from the lack of trust lay people have in scientific experts or expertise. However, what is unclear is if this theory holds true in countries outside of the United States (e.g., in South Africa where pesticide labels are used to communicate pesticide hazards). That is, are there risk communication problems experienced in developing countries? If so, what are these problems and their potential causes (e.g., trust or loss of trust)? Sjöberg (2000b) argues that the concept of trust appears to play a less significant role in European countries than in the USA (it is unclear whether this is because the dimension of trust is less important outside of the USA or if the level of trust in other developed countries is higher than in the USA). As very few sociological risk perception studies have been conducted in developing countries, it is unclear how the concept of trust would be

perceived in these contexts and whether it is as applicable and useful concept as in the studies conducted in the USA.

According to Pidgeon et al. (1992), trust penetrates the risk communication debate in two unrelated ways. The first being the issue of the credibility of a communicator (i.e., messenger) is dependent on the trust placed in this person; the second being the issue of risk assessments incorporating social framing assumptions. The argument is that if the source is not trusted than the message is not trusted. Several factors affect how trust of the source communicating the risk(s) is viewed. Figure 10 gives a summary of the various factors different authors have identified. However, the fact that authors have identified varying factors indicates that the "social reality" of the perceiver influences which factors of trust are important for them and these will vary with cultural and ethnic variances in a society.

Figure 10: Perceived Factors Influencing Trust

- Competence and expertise
- Objectivity
- Fairness
- Consistency
- Good will
- Commitment to a goal
- Fulfilling responsibilities
- Caring and empathy
- Predictability
- Dedication
- Honesty and openness
- Consensual values

Source: Adapted from Bennett (1999); Kasperson et al. (1992); Covello (1992); Johnson (1999)

3.3.3. Summary and Research Questions

When evaluating the effectiveness of pesticide labels as a hazard communication tool for South African farm workers, the point repeatedly emphasized above is that all risks are both objective and subjective; thus the lay, as well as expert risk perceptions need to be assessed in an effort to move beyond the traditional top-down approach to risk

communication strategies. Rather than relying on risk perception studies to manipulate and improve on the education of the target audiences (which is predominately the case in the United States), risk perception research can highlight the short-falls in risk communication strategies to make it possible to adjust these strategies rather than adjusting perceptions. As Taylor (1999: 152) aptly states, there is a need "to shift the risk culture to include 'risk avoidance' where scientific uncertainty is too great and the potential adverse consequences too severe. This judgment requires reframing of the problem to take in the 'big picture' questions (often value-based) left out by traditional risk assessments but often glaringly obvious to the public." Taylor's point highlights the fact that traditional risk communication tools (including pesticide labels) do not promote avoiding exposure to the risk; rather they focus on re-educating the target group, shifting perceptions, and in the case of industry, shifting liability onto the end user. That is, technical rationality is used to influence cultural rationality through risk communication (e.g., training on "safe use" of pesticides; see Chapter Two).

In line with the research hypothesis that there exists an interaction between risk perception and risk communication, the following questions are addressed in this dissertation: What risk perceptions do South African farm workers have in relation to pesticides? Do pesticide labels influence these risk perceptions? Do South African farm workers' risk perceptions influence the way in which they process and implement the information on hazard communication tools? Do pesticide labels elicit behavioral intentions that will protect human health and the environment from the potential toxic effects of pesticides? If not, what are the factors affecting their effectiveness?

CHAPTER FOUR

METHODOLOGY AND DATA COLLECTION

4.1. INTRODUCTION

This chapter outlines the qualitative and quantitative methods used to address the research questions in regard to farm workers pesticide risk perception, the effectiveness of the pesticide label as a risk communication tool, and the interfacing between risk perception and risk communication.

4.2. METHODOLOGICAL APPROACHES

The preceding chapters have highlighted the discourse and tension between the technological and cultural views of risk. As with the methodological dichotomy that exists in the social sciences in general, there also exists a methodological dichotomy in the risk perception and risk communication literature between the use of quantitative research approaches (e.g., analysis of statistical relationships between *a priori* variables measured in general surveys) and qualitative research strategies (e.g., case studies, extended interviews, participant observation, ethnography) for examining the social realities of risk. However, Dabbs (1982) aptly highlights that qualitative and quantitative are not separate and unrelated. While both qualitative and quantitative methods have unique contributions to make to our analysis of social phenomena, qualitative methods can also be employed to provide a more in depth explanation to the findings of quantitative research, and quantitative methods can also be used to provide statistical insights to understandings developed initially in qualitative research (Denzin 1978). The

methodological dichotomy discussed above has influenced the methods used in this dissertation for understanding pesticide risk perception and for analyzing pesticide labels as a risk communication tool. Therefore, both qualitative and quantitative methods were employed for data collection in order to address the research questions. Qualitative research methods were used to highlight the social dimensions influencing farm workers perceptions of pesticides and pesticide risks, along with highlighting the social dimensions influencing their interpretations of the pesticide label components. Quantitative survey methods were used to collect demographic data on respondents, respondents understanding of pesticide risks and the pesticide label components, as well as test the applicability in a developing country of some of the methods discussed in the risk perception literature review (see the psychometric and health belief models in Chapter Three).

A challenge in this research was applying risk perception and risk communication quantitative data collection methods from the literature to a developing country context, when most of these had previously been applied in a developed world context. For example, the study populations generally researched in mainstream risk perception literature have beyond a high school educational level and are familiar with the questionnaire techniques used in the literature (e.g., attitude questions, risk ranking, gauging responses on a Likert scale). This research questions the applicability of these methods to populations with little or no formal education (e.g., farm workers).

4.3. DATA COLLECTION METHODS

The qualitative data for this dissertation was sourced from documents, focus groups, informal discussions and researcher field observations, while the quantitative data was obtained through administering a questionnaire. The following sections discuss the data collection strategies employed and provide information on the context of the research site.

4.3.1. Focus Groups

A focus group was held using the "thinking aloud" and "free association" techniques employed by the Mental Models Approach discussed in Chapter Three. The outcome from this informed the structured interviews through the design and composition of the survey instrument. The focus group, with five women in the Western Cape wine farming area of Stellenbosch, was organized through a local farm workers' organization -- the *Women on Farms Project*. One purpose of the focus group was to tease out the language used by the workers to express various technical pesticide terms and to find out whether the English meanings of these terms transferred to Afrikaans. The questionnaire needed to be available in Afrikaans as this is the predominant language spoken amongst farm workers in the Western Cape.

Four words commonly used in English to express the hazardousness of pesticides are poisonous, dangerous, toxic and risky. In the English language these four terms express subtle nuances in conveying information about hazards, and each of these words has slightly different connotations. That is, *dangerous* refers to having the ability to cause harm. *Risk* is a subset of danger and refers to the chance or possibility of danger. Poisonous and toxic are subsets of risk. *Poisonous* refers to a substance that can cause

death or injury, and *toxic* implies relating to or caused by a poison. The point is these words are used in English for pesticide risk communication to express subtle differences in hazardousness. The question is whether these variations in hazardousness are expressed when translated into Afrikaans?

The skull and cross bones icon is used on pesticide labels simultaneously with the signal words "very toxic" or "toxic", although the actual icon refers to "extremely hazardous" and "highly hazardous". "Very toxic" is used when the pesticide is classified as a Group Ia (extremely hazardous) pesticide (see Chapter Two, section 2.5.3. for how pesticides are classified). "Toxic" is used as a signal word when the pesticide is classified as a Ib (highly hazardous) pesticide. The color codes used on pesticide labels in South Africa represent varying levels of toxicity and are used in connection with some pictograms (e.g., the yellow color code is always with the St. Andrew's Cross; see Chapter Six) and some signal words (e.g., the yellow color code is accompanied by the word "harmful"). The word poisonous is used in hazard statements and first aid statements on the pesticide labels. Risk communicators indicate whether a particular pesticide is "risky" or not by whether the words danger, poisonous or toxic are or are not presented on the pesticide label.

The significance of the definitions of the above words in English necessitated the need to test if there were Afrikaans words for these and then to test whether farm workers could understand and/or make distinctions between these words. Poisonous (*giftig*) and dangerous (*gevaar*) were well understood. However, even though there are words in Afrikaans for toxic (*toksies*) and risk (*risiko*) these were not understood and are viewed as technical Afrikaans not used colloquially. Toxic in Afrikaans is usually referred to as

poisonous (i.e., *giftig*); whereas, risk is usually referred to as hazard. Hazard in turn is referred to as danger (i.e., *gevaar*), as well as dangerous (*gevaarlik*) is translated as hazardous. This tautology created somewhat of a problem with the question about color codes, as color codes represent different levels of toxicity. The translator for the questionnaire used the word *gevaarlik* (dangerous) in brackets next to the word toxic to aid respondents with understanding the meaning. However, the problem with this interpretation is that the meaning and differences represented in English between dangerous (capable of causing harm) and toxic (capable of causing harm through biochemical mechanisms when exposed) was lost (Bosman et al. 1991).

Another purpose of the focus group was to test some of the questions and the question categories, as well as to ascertain whether there were questions missing. One finding was that the women were distinguishing between acute and chronic effects of pesticides. That farm workers would make this distinction was an unexpected outcome. As a result, questions on acute and chronic effects were added to the final questionnaire in order to ascertain whether farm workers in general make this distinction and how they perceived the difference(s) between the two (i.e., which effects are perceived as riskier?).

Another finding from the focus group concerned exposure to pesticides. When asked if any of the focus group participants had seen any one being affected by pesticides, one of the responses was: "Women get rashes because they have urinated in the vineyards because there are not toilets provided." This comment is an important finding in terms of exposure scenarios. It is unlikely that the questionnaire would have drawn out this comment given the structured nature of survey interviewing. However,

the informal atmosphere of a small group composed only of women provided a context that made possible this type of information.

Four additional focus groups were run after the interviews were completed in order to clarify issues emanating from the questionnaire responses and to discuss the responses in further detail. These focus groups were held on one table grape producing farm. The groups were divided into: (1) women general farm workers, (2) men general farm workers, (3) men working directly with pesticides, and (4) male and female farm worker supervisors.

4.3.2. Designing of the Questionnaire

The questionnaire (composed of both open- and closed-ended questions; see Appendix A) was developed[19] to address the research questions and methodological objectives, and to capture information on:

a) demographics (e.g., age, gender, education)

b) pesticide knowledge
   i. the concept of "poisonous"
   ii. previous pesticide training experience

c) pesticide perceptions
   i. relative risk perceptions of pesticides and other hazards
      - using risk ranking
   ii. previously poisoned by a pesticide

d) label experience

e) label knowledge
   i. understanding of purpose of label (i.e., defining use of information found on the label)

f) ability to read label
   i. general literacy

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[19] I would like to thank Prof. Tom Arcury for sharing his questionnaire used in his work (Arcury et al. 2002) which informed and influenced aspects of my survey design.

ii. comprehension of:
- color codes
- technical language
- precautions
- icons (i.e., interpretations of pictograms)
- signal words

g) pesticide protective behaviors

The questions were designed in sections in order to answer the research questions and accomplish the methodological objectives. One of the construction issues was how to measure the relative ranking of risks. Previous research I conducted (Rother unpublished research, 2000) revealed that ranking risks was problematic for farm workers. In this previous study, farm workers' abilities to rank risks were assessed. Farm workers were given ten risks relevant for their social and cultural context and asked to rank them in order of most dangerous to their health to least dangerous. Generally, the farm workers struggled immensely, first to understand the purpose of the exercise, second to figure out what they personally thought, and third to actually remember all ten items as many could not read. The interviewers assisting me with this project found this ranking question too difficult and very time consuming to administer. Therefore, for the present project, I chose to give farm workers only three risks to rank at a time, but expanded how they perceived pesticides to be risky in relation to other risks across several questions.

In the United States, Likert scales are commonly used in risk perception questions. However, as the study populations in US studies are predominately university students or others with a formal education, they appear to have no problem locating their responses on a continuum of graded responses (e.g., very dangerous, somewhat dangerous, moderately dangerous, not so dangerous, not dangerous at all). However, the

Likert scale approach of gauging one's response in terms of five levels of affect is a foreign and difficult concept to a population with predominately a primary school education or less. On the basis of my previous research (cited above), I believed that the use of a five point scale would have frustrated both farm workers and interviewers in this study. Therefore, in this study I opted for yes, no and don't know responses for questions on perceived risks from exposure to pesticides and perceived message of hazard information on the pesticide label. This study did test a three level Likert scale for three questions on protective behavior (see question F.2 in Appendix A). For the most part, the three level scale worked.

The questionnaire was written in English and then circulated to several academics at Michigan State University and the University of Cape Town for input. As farm workers in the Western Cape predominately speak Afrikaans, the questionnaire was translated into Afrikaans. This was accomplished by one person and then back translated into English by another. The questionnaire was piloted through the Women on Farms Project group in the Stellenbosch area near Cape Town.

Face-to-face interviews were predominately conducted in Afrikaans. Xhosa[20] speaking farm workers chose to be interviewed in either English or Afrikaans. A Xhosa speaking interviewer was organized should a person have required questions to be asked in Xhosa, but this was not utilized. The questionnaire was not translated into Xhosa as pesticide labels in South Africa are not written in Xhosa and the results needed to reflect whether the language of the label (i.e., English or Afrikaans) is an issue. Several Xhosa speaking farm workers did make the comment that pesticide labels should be written in

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[20] In the Western Cape as a whole Xhosa is the most commonly spoken African language amongst black Africans.

Xhosa. As all study participants had varying degrees of fluency in English or Afrikaans, there is no reason to assume that the Xhosa speakers interviewed in any way biased the study results.

4.3.3. Implementation of the Questionnaire

As previously indicated that farm workers in the Western Cape predominately speak Afrikaans, the services were enlisted of four Afrikaans speaking environmental health students from the Peninsula Technicon[21], three females and one male. All of these students had previously administered field questionnaires dealing with some aspect of pesticides for faculty in the Department of Public Health and Primary Health Care at the University of Cape Town and were familiar with conducting research with farm workers in the Western Cape. One of these students was working on her masters degree and was the lead research assistant for this research. She assisted with contacting farms and speaking to farm owners who struggled with English, and also conducted health and safety training sessions for farm workers after the interviews (see Participatory Training as a Qualitative Method in section 4.4.1.).

I trained the four interviewers in the implementation of the questionnaire generally, and specifically in probing techniques. After the first field interviews, I reviewed each questionnaire and made suggestions to the interviewers on how to improve on probing for, and obtaining more, in depth responses to the open-ended questions. The interviewers reported back early on that the farm workers interviewed were asking them a lot of questions about pesticides and pesticide labels that they were unable to answer.

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[21] Technicons are degree offering institutions that offer more technical degrees than academic. The Peninsula Technicon is considered a historically disadvantaged institution which was meant for colored and black students during the apartheid years.

Thus I then ran another training session with the interviewers providing training on basic health and safety issues related to pesticides. Each interviewer was given a manual, for reference, covering various aspects of pesticide issues relevant to farm workers that I had developed for a previous project I was involved in with the University of Cape Town.

Risk perception and attitude research initially proved to be complex for these interviewers who were more familiar with administering closed ended questions on health issues and not so much on soliciting beliefs. However, the interviewers were receptive to the qualitative research methods training and guidance, especially on probing techniques. One interviewer, who had previously prided herself on being immensely fast at interviewing and writing short responses, took great pride in presenting detailed statements in response to open-ended questions.

Another new concept for the interviewers was that of acting as the pen to the voice of the farm workers. Initially they wanted to explain and coach the respondents through the various questions. However, this changed when interviewers were encouraged to report "honest" responses (even ones that did not make sense to them) and they appreciated and understood the importance of such responses.

4.3.4. Difficulties with Perception Research

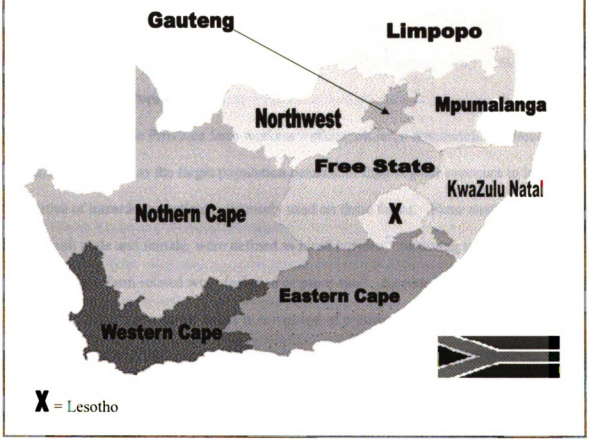
The research interviewers had all previously conducted face-to-face field interviews on pesticide issues using a questionnaire. However, they reported to the researcher that this was the most difficult questionnaire to administer as it was soliciting information on what people "think", "believe" and "feel". The interviewers perceived the research they had previously conducted to be straightforward and soliciting "facts". Encouraging the interviewers to think laterally and beyond facts was a developmental

process throughout the field research. A challenge faced was disentangling the interviewer's frame of reference and perception from the interviewee's frame of reference and perceptions. This is why I found it vital to couple the quantitative findings in this research with qualitative methods in order to validate and explain the statistical findings. However, all of the field interviewers said that this research project was the most exciting project they had thus far worked on and that they learnt an enormous amount about research. One interviewer stated that the learning experience on how to conduct research was more educational than any other project this interviewer was previously involved in.

4.3.5. Research Site

This research was conducted in the Western Cape Province of South Africa -- one of nine provinces located in the south of the country (see Figure 11). The Western Cape Province is a concentrated agricultural area for horticulture, livestock and field crop production. Horticulture is the leading agricultural sector in this province, with a predominate focus on deciduous fruit production largely for export and viticulture products. In 1994, deciduous fruit and viticulture contributed 41.9 percent of the gross value of South African horticulture production (SA Statistics 1995). The most labor-intensive farming sector in the Western Cape is wine and fruit production. The horticulture sector provides permanent on-farm employment for about 63,000 people; if one converts seasonal workers to full-time equivalents, seasonal employment in the horticulture sector is about 84,000 people (Lipton et al. 1996a). Large commercial operations dominate agricultural production in the Western Cape, but there are a few small-scale enterprises.

Figure 11: Map of the Nine Provinces in South Africa



As horticulture production in the Western Cape is geared for an export market and many farms adhere to international standards and protocols, farm workers in this province are expected to have better training and information resources than those in other provinces. Also, many farm workers work on large-scale operations that in theory should have more access to information sources than those on smaller operations (Rogers 1962). Thus one would expect that, if there are differences between the provinces, the farm workers in the Western Cape Province would be better informed and protected than workers in other provinces.

4.3.6. The Study Population

Western Cape Province farm workers working on large commercial horticultural farms were selected as the target population because of their regular exposure to large quantities of hazardous pesticides intensely used on these farms. Farm workers in this study, both male and female, were defined as hired persons[22] receiving payment for labor-intensive farm related work (salaried or piece-rate). As noted above, the labor force on the large commercial farms is composed of permanent workers, who live on an area of the farm in small concentrated housing complexes, and of seasonal workers. Different cultural groups make up this labor force. Permanent farm workers are predominately colored[23] and regarded as more suitable for skilled employment, whereas seasonal workers are mostly of African descent (e.g., Xhosa) and are predominately given less skilled jobs (Lipton et al. 1996a).

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[22] Members of the owner's family that work on the farm usually do so in managerial capacities and do not do labor intensive work. Thus they are not considered "farm workers" in the context of this research.

[23] An apartheid era term which legally defined people of "mixed race". In 1996, 58.6% of the population in the Western Cape were colored as compared to only 8.4% in South Africa as a total (Moeller 1998).

Farm workers have historically been a marginalized group, living and working in poor conditions (e.g., limited running water in homes, lack of sanitation facilities, limited access to electricity). Compared to urban unskilled workers, farm workers have in the past earned consistently less. Illiteracy rates have tended to be high amongst older farm workers. However, a profound trait of farm workers has been the social problems resulting from their impoverished lifestyle and the legacy of remuneration with alcohol. As stated in Chapter One, a unique feature of Western Cape agriculture has been the "dop" system which was the institutionalization of alcohol for payment and social control of employees (London et al. 1998). This legacy has left the farm worker community plagued with alcohol abuse, domestic violence and a high suicide rate. This is significant both for this research's contextual analysis and also because pesticides have been noted to react adversely with alcohol consumption (Hayes 1982).

4.3.7. Farm Laborers' Gender Division

Women farm workers play an important role in agricultural production. In the Western Cape, women make up 59 percent of the deciduous fruit industry work force and 57 percent of the work force for table grapes and the apple industry (Women on Farms Project 1997). In 1998, women comprised 40 percent of the permanent work force and 70 percent of the seasonal work force (ibid).

There is also a gender division of skills and tasks on Western Cape farms as women are viewed to be better pruners then men, but are also viewed as unable to

conduct more "strenuous" jobs. Generally this gender division incorporates the concept that men must spray pesticides, as women are unable to execute this task.[24]

4.3.8. The Farm Worker Study Sample

Altogether 115 farm workers, 69 men and 46 women, comprised the sample for this research. Of the study participants, 52 were farm workers on fruit farms and 62 were farm workers on wine farms; one female farm worker was working in a restaurant at the time of the interview.[25]

4.3.9. Selection of Farms and Farm Workers

The workers in the sample were obtained by two different methods. A large majority (105/115) of the study sample was selected from 13 farms in two horticultural production areas (one predominantly fruit/table grapes and the other predominantly wine grapes). The farms that were invited to participate were taken from several sources:

- A list of wine farms was down loaded from the internet
- The Women on Farms Project contacted farms for the researcher
- One of the local pesticide companies had five of their sales representatives ask farmers about participating in this study
- Environmental Health Officers in the districts were contacted for help with identifying farms
- A faculty member at UCT gave contact details

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[24] In one focus group, several male farm worker supervisors joked how spraying was too difficult of a job for women and that women were not capable of conducting this work. They also remarked that women had to look after the children which interfered with spraying activities.

[25] Women registered at the Work Force employment agency (see section 4.3.9.) do not only conduct farm work, but other part time work as well. This woman was not a farm worker per se at the time of the interview.

- An apple cooperative asked their members for willing members to participate

After sourcing a contact either the lead research assistant or I phoned the farm owner or farm manager to inquire about participation in this research. The purpose and method of the research was explained, and then each person who was interested was faxed or e-mailed a more detailed letter explaining the research questions and confidentiality provisions. In general the research was well received; most people contacted were interested in participating. However, many could only participate several months later due to harvesting. Approximately 30 farms in total were contacted to participate in this study. Participating farms were selected based on whether they were willing to participate and able (i.e., time wise) to participate. All farms contacted were representative of the farms in the area in terms of the crop they produced, in that they were producing for export, and in that they used pesticides extensively.

Participating farms were asked to select farm workers to be interviewed who conduct a range of tasks and not only those designated as sprayers or spray tractor drivers. An attempt was made to limit farm workers interviewed per farm to ten in order to avoid statistical clustering (i.e., the assumption is that similar respondent profiles occur on a farm thus leading to similar responses from that farm).

The project aim, objectives and human subjects' procedures were explained to all participating farmers and farm workers. In exchange for interviewing time, pesticide health and safety training[26] was offered to all participating farm workers, along with a

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[26] South African farm workers lack sufficient training and exposure to pesticide information. Previous studies have found that farm workers have been very eager to participate in training, especially after responding to a questionnaire, as they want to find out what the correct answers are. Offering training as an

guide/card on the meaning of label pictograms and color codes. On the 13 selected farms, 109 farm workers were approached to participate in this study; however, four farm workers (one man and three women) declined to participate after the consent form was read to them.

As the research progressed, it became more difficult to source enough women farm workers per farm in relation to the men being interviewed. What emerged was that there were predominately less female permanent workers as many farmers were downscaling their permanent labor force to very small numbers (e.g., five, three and in one case to one person only). Although the reason for this was not clearly stated, the impression was that the new Farm Worker Legislation, which was recently enacted, was a catalyst for this move. Farm workers under the apartheid regime were subjected to some of the most severe human rights abuses as the agricultural sector was unregulated (see Chapter Two). The present government has made a move to make farm workers less dependent on a system where farm owners determine their life style structures (e.g., housing, schooling, medical treatments) through improving their financial circumstances so as to enhance individual decision making (e.g., higher wages along with now having to pay for rent and electricity). Instead of keeping a large permanent work force, farmer owners seem to rely even more on sourcing seasonal staff through labor contractors in order to bypass the new farm worker legislation.

A large labor-contracting firm in South Africa, *Work Force Ltd*, provides farm workers to many of the farms participating in this study. In order to source more female farm workers, the Work Force office in Stellenbosch was contacted. Ten women farm

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incentive for participation works well both for the under-trained farm workers, as well as for the farmers who by law should be offering training to their workers.

workers who were approached by Work Force agreed to participate in the study and were interviewed at the main Work Force office. The project aim, objectives and human subject's procedures were explained to the Work Force staff and the ten women farm workers. As above, in exchange for interviewing time, pesticide health and safety training was offered to the ten women farm workers, along with a guide/card on the meaning of label pictograms and color codes. Farm workers interviewed through Work Force were asked what was produced on the last farm they worked on in order to classify the workers in regard to horticultural production.

4.3.10. Respondent Characteristics

The farm workers from the 13 participating farms and from the Work Force employment agency totalled 115. Although there were difficulties in finding enough female farm workers to participate in this study (see above), the final balance of 40 percent females to 60 percent males was deemed adequate for making assessments based on gender. Although the respondents ranged from age 19 to age 60 (see Table 4), the bulk of respondents fell between 20 and 49 years of age (89.5 percent), with the 30-39 year olds comprising the largest age category of respondents (39.1 percent). In terms of education, 46 percent had not completed their primary education (Grade One – Seven), while 35 percent had not completed their secondary school education (Grade Eight – Twelve). Occupational positions held and language proficiency is discussed in detail in Chapters Five and Six respectively.

TABLE 4: Research Subjects' Attributes (N = 115)

	(%)
Gender	Female: 40 Male: 60
Age Range	16 - 19 years: 1.7 20 - 29 years: 22.6 30 - 39 years: 39.1 40 - 49 years: 27.8 50 - 59 years: 7.8 60 – 69 years: .9
Educational Level	No formal education: 7.0 Did not complete Primary School[27]: 46.1 Completed Primary School: 6.1 Did not complete Secondary School: 34.8 Completed Secondary School: 5.2 Did not complete tertiary education: .9 Completed tertiary education: 0.0
Job Description Breakdown of "Farm Workers"[28]	Sprayman: 34.8 Foreman or Supervisor: 8.7 General Farm Worker: 73.0 Spray Tractor Driver: 30.4 Other: 7.2
Language Proficiency	Speak Afrikaans fluently: 80.9 Read Afrikaans fluently: 57.4 Write Afrikaans fluently: 52.2 Speak English fluently: 11.3 Read English fluently: 15.7 Write English fluently: 13.0

4.3.11. Exclusion of Previous Poisoning Variable From Analysis

A hypothesis in this study was that exposure to a previous poisoning incident is an influence on risk perception ultimately influencing safety behavior. Therefore, in the questionnaire, respondents were asked it they had previously been poisoned by a pesticide. However, only six percent of respondents reported that they had previously been poisoned and 10 percent did not know whether they had been poisoned or not.

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[27] In South Africa, Primary School is from Grade One to Grade Seven and Secondary School is from Grade Eight to Grade Twelve.

[28] Farm workers could have more than one of the job categories as is evident from the percentages.

The study findings showed that farm workers in South Africa did not generally mentally register their experience of having a biophysical pesticide exposure (i.e., being poisoned). It is, therefore, argued that the biophysical poisoning incident does not in and of itself influence risk perception. Instead the individual needs to have some mental interpretation of the incident (usually a negative experience) in order for risk perception to be influenced.

As the percentage of positives to this question was far too low for generating meaningful statistics, the variable of previous poisoning incident was left out as a background influence on perception in this study. Instead, the variable "ever made sick by pesticides" was used as the previous experience variable (discussed in Chapter Five) since 29 percent of respondents gave a positive response to this variable.

Although previous poisoning incidents had to be left out in the analysis section, at this point some discussion is warranted as to potentially why this variable had a low response. The purpose for including this variable in the questionnaire was twofold: (1) because the risk perception literature claims that personal context and circumstances, such as experiencing a pesticide poisoning, has a strong influence on perception (Langford et al. 2000a; Krimsky and Golding 1992) and (2) because of the significance of previous experience, to determine what respondents understood poisoning to mean. Not until the questionnaire data was entered into SPSS and analyzed did it become apparent that the response rate was low for previous poisoning question and that respondents may have been confused or culturally biased (i.e., associated poisoning negatively with suicide attempts; see below) as to what "being poisoned by pesticides" meant. Consequently, no attempt could be made to give respondents a technical

definition of "to be poisoned". However, as stated, the intention was more to assess what respondents perceived rather than "correcting" perception for further questioning. Furthermore, as 15 percent of respondents indicated that pesticide poisoning occurs through drinking or swallowing a pesticide. The assumption is that respondents in this study were equating pesticide poisoning with possible suicide attempts through pesticide use. Pesticide induced suicide attempts are high amongst farm workers (further discussed in Chapter Five) and suicide has a negative social and cultural connotation amongst farm workers. Further investigation of this assumption was beyond the scope of this dissertation, however, should be the topic of research in the future.

4.4. ADDITIONAL DATA COLLECTION METHODS

Two additional data collection methods were used to inform the research findings. One was the informal training offered post-interviewing (see section 4.4.1.) which stimulated relaxed informal discussion. Another was the informal discussions I had with the farm owners, managers, health and safety officers, environmental health officers and respondents while the interviewers conducted the interviews with the farm workers. I was taken around the farms observing the chemical stores, safety equipment, and the farm workers' work and housing conditions, and I was told stories about practices on the particular farms. These were both useful in understanding the social and cultural context farm workers work in, as well as giving insight into some of the questionnaire responses.

Invaluable contributions to this research came from the numerous informal discussions I also had with the four interviewers during long car trips to and from the field, as well as while waiting for farm workers or waiting for some of the interviewers to

finish. It was during these conversations that the interviewers would discuss problems they were experiencing with administering the questionnaire or relate stories and information that the respondents had told them. Often in these discussions, interviewers would give full descriptive accounts and detail of many of the responses interviewers often only briefly wrote about on the questionnaires. Based on these numerous conversations, I was able to understand and put into context the questionnaire responses.

4.4.1. Participatory Training as a Qualitative Methodology

All study respondents participated in a brief participatory training session upon completion of the interview. I had designed a small pocket size card in Afrikaans and English, which gave the FAO and pesticide industry definitions of the pictograms and color codes found on pesticide labels (see Chapter Six), and which was used in the training session. Participants were encouraged to teach their children and others to recognize and understand these components of the label. These were positively received and were a non-monetary form of acknowledging the time participants took to work through the questionnaires.

A fair amount of research is conducted on Western Cape farms and I was sensitized to not only making clear that the farm owners and names of the farms would not be disclosed in the results, but to also give the farmers a benefit from participating. As farms now must comply with the Health and Safety Act and provide their workers with regular training, the training session gave farmers an opportunity to fulfil this mandate.

The training session not only served the purpose of giving a benefit to study participants, but also provided a forum for more interactive qualitative research.

Participants were shown a series of pesticide health and safety posters that were designed and developed by the Occupational and Environmental Health Research Unit in the Department of Public Health and Primary Health Care at the University of Cape Town and asked to comment on what was occurring in the pictures. This approach provided participants with the opportunity to share their views and for the researcher to gain more insight into the issues affecting farm workers' pesticide risk perception, as well as problems with the pesticide label as a risk communication tool in the Western Cape.

4.5. DATA ANALYSIS APPROACHES AND PROCESS

Each completed questionnaire was coded and entered into a questionnaire builder built by the researcher in Epi Data Version 2.1b as a data bank template for all the results. Once all 115 questionnaires had been entered, the data file was then transferred into SPSS 11.0 for analysis. Descriptive statistics, including frequencies, percentages and cross-tabulations, were generated on the various questionnaire variables in order to address the research questions. In Chapters Five and Six, the questionnaire findings are presented in conjunction with the results from the analysis of the qualitative research findings discussed below.

A codebook analysis approach was used to analyze the various qualitative data collected. The author created a 50-page code booklet for all the open-ended questions in the questionnaire and for comments made to interviewers not captured in the questionnaire format, along with field observations. Information was entered into the code booklet initially under each question. Thus, the closed-ended information was entered into the questionnaire builder, while the open-ended information was entered into

the codebook. This code booklet provides the ethnographic data presented in Chapters Five and Six. During the creating of this code booklet, headings and themes were stimulated that were immediately listed under either the risk perception section (Chapter Five) or the risk communication section (Chapter Six). Although some section headings relate to the variables and section headings in the questionnaire (quantitative variable category selection), others were stimulated from the responses to the open-ended questions and the informal information (qualitative category selection). The responses in the codebook were categorized into recurring themes across respondents in order to provide insight into, and describe, respondents' risk beliefs (mental models). The interpretative approach of content analysis was used for both the findings in the code booklet, as well as for an analysis of the pesticide label.

CHAPTER FIVE

SOUTH AFRICAN FARM WORKERS' RISK PERCEPTION

5.1 INTRODUCTION

In line with the literature on risk perception discussed in Chapter Three, this chapter presents the findings of the study which indicate the individual farm worker's perceptions (i.e., attitudes and beliefs) of pesticide risks. The findings are presented as quantitative statistics, along with qualitative ethnographic text. Conclusions from these findings are used to assess the social and cultural framing effects on farm workers' individual perceptions and worldviews. This chapter is divided into sections presenting the study findings (Section 5.2), the discussion of the results (Section 5.3), and the conclusions (Section 5.4).

5.2 FINDINGS

The risk perception findings of this study are presented in two subsections: the content of the perception of pesticide risks (Section 5.2.1), and the background influences on perception of pesticide risks (Section 5.2.2).

5.2.1 Content of Perception of Pesticide Risks

This first section of the study findings illustrates the study participants' cultural rationality by presenting their mental models of the risks associated with pesticides; these findings about the perception of pesticide risks are presented under the rubrics of

pesticides, the purpose of pesticides, pesticide risks, health effects, routes of exposure, and exposure prevention.

5.2.1.1 Perception of Pesticides

In this study respondents had different interpretations of "pesticides". Previous research with farm workers and small-scale farmers in Northern and North West Provinces of South Africa (Rother 2000, unpublished research) indicated that there is some confusion between chemicals classified and registered as pesticides[29], and chemicals (e.g., household cleaners) that are not officially considered to be pesticides. To test this issue with farm workers in the Western Cape, study respondents were given nine items (see Table 5) and asked whether each item was a pesticide (question B-3 in Appendix A). This question was intended to determine by classificatory behavior what the respondent understood a pesticide to be. The first three items listed, which are classified and registered as pesticides in South Africa, were predominately cited by respondents as being a pesticide (e.g., *Doom* – 91.3 percent; dips for animals – 81.7 percent; lice shampoo – 73.0 percent).

Of significance is that 70 percent of respondents believed *Harpic*, a toilet cleaner, was a pesticide, that 32 percent of respondents felt room fresheners were a pesticide and that 30 percent believed washing detergents were a pesticide.

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[29] *Pesticide* is referred to by the Department of Agriculture, in the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act 36 of 1947) as an "agricultural remedy" and defined as follows: "Any chemical substance or biological remedy, or any mixture or combination of any substance or remedy intended or offered to be used: i) for the destruction, control, repelling, attraction or prevention of any undesired microbe, alga, nematode, fungus, insect, plant, vertebrate, invertebrate, or any product thereof, but excluding any chemical substance, biological remedy or other remedy in so far as it is controlled under the Medicines and Related Substances Control Act, 1965 (Act No. 101 of 1965), or the Hazardous Substances Act, 1973 (Act No. 15 of 1973; or ii) as plant growth regulator, defoliant, desiccant or legume inoculant, and anything else which the Minister of Agriculture has by notice in the Gazette declared an agricultural remedy for the purposes of Act 36 of 1947." This Act is currently under review and the Department of Agriculture is proposing to change the word "agricultural remedy" to "pesticide".

TABLE 5: Assessing Farm Workers' Beliefs of What Is and Is Not a Pesticide (N=115)

Believe the Following is a Pesticide	YES (%)	NO (%)	DON'T KNOW (%)
Doom (household insecticide)	91.3	6.1	2.6
Dips for animals	81.7	13.9	4.3
Shampoo for lice control	73.0	20.0	7.0
Harpic (toilet cleaner)	69.6	27.0	3.5
Room fresheners	32.2	61.7	6.1
Omo (clothes washing powder)	29.6	64.3	6.1
Vinegar	16.5	76.5	7.0
Cooking Oil	10.4	83.5	6.1
Vaseline	5.2	91.3	3.5

Initially the items in the question for Table 5 were pesticides and household chemicals (i.e., the household pesticide – *Doom*; washing powder; toilet cleaner; room fresheners; dips for animals; lice shampoo). In an effort to balance this list of chemicals and reduce the effect of leading questions, Vaseline, vinegar and cooking oil were added as "throw-away questions" (Berg 2001). However, three quarters of the way through the interviewing, it became evident that many people were listing vinegar as a pesticide (16.5 percent in total). On inquiring, the researcher found that many of the farm workers do indeed use vinegar as a pesticide to kill insects in their homes, such as ants. This might suggest that the respondents are using functional or operational criteria for their classifications, rather than legal criteria of pesticides (see footnote 29 above). Subsequently, the United States Department of Agriculture has released information indicating that vinegar is a potent herbicide (see http://www.ag.auburn.edu/landscape/STGOjune2002.html).

Table 6 illustrates respondents' belief about the items in Table 5 in relation to whether they were actually a pesticide or not. That is, 27 percent of farm workers correctly identified those substances in Table 5 that were pesticides, whereas 18 percent incorrectly identified a non-pesticide to be a pesticide. Similarly, six percent of workers

indicated a substance that was a pesticide to be a non-pesticide, in relation to 49 percent of farm workers who correctly identified a substance that was not a pesticide as a non-pesticide (see Table 6).

TABLE 6: Belief That a Substance Is a Pesticide in Relation to Actual Pesticides (N = 115)

Believe Substance is a Pesticide		Substance is a Pesticide (%)		
		Yes	No	TOTAL
	Yes	27.3	18.2	45.5
	No	6.0	48.5	54.5
TOTAL		33.3	66.7	100

5.2.1.2 Perception of Purpose of Pesticides

To further assess respondents' understandings of what pesticides are, respondents were asked what they thought pesticides are used for as an open-ended question, first unprompted[30] and then prompted (see question B-4 in Appendix A). Several findings are noteworthy. Perhaps most importantly, less than four percent of the respondents, either unprompted or prompted, gave what is the most correct answer – "to kill/destroy pests" (see Table 7).

Second, when asked without prompting, the bulk of respondents indicated that pesticides are for killing insects (67.8 percent) or more specifically, for crop insects (42.6 percent). Third, only 20 percent of respondents said without prompting that pesticides are for killing weeds, and an additional 51 percent responded positively to the prompt for

[30] Unprompted meant that the question, "what do you think a pesticide is used for", was asked and respondents gave whatever replies they thought of; interviewers continued to solicit additional responses until the respondent indicated that s/he could not think of anything else. Then respondents were given seriatim a list of six statements and asked if they thought these were the purpose of pesticides (e.g., for general cleaning, to kill weeds, to kill insects). Prompted statements were not asked if the respondent had already mentioned it as unprompted.

killing weeds. Thus almost 30 percent of the farm workers were not classifying herbicides as a pesticide.

TABLE 7: Farm Workers' Perception of the Purpose of Pesticides (N = 115)

Question B-4: What Do You Think Pesticides Are Used For?			
	Unprompted (%)	**Prompted** (%)	**TOTAL** (%)
To kill insects	67.8	27.0	94.8
To kill crop insects	42.6	47.8	90.4
To kill weeds	20.0	51.3	71.3
To produce better fruit	10.4	67.0	77.4
To keep you healthy	8.7	33.0	41.7
For general cleaning	3.5	40.0	43.5
To kill/destroy pests	3.5	N/A	3.5
To kill germs	2.6	N/A	2.6
Don't know	7.0	N/A	7.0

Respondents could give more than one answer.

Fourth, only four percent of respondents indicated, unprompted, that pesticides are used for general cleaning (i.e., as a household general cleaning product). However, when prompted by the interviewer, 40 percent of respondents indicated that pesticides are for general cleaning purposes (see Table 7). A 43 year old farm worker who had worked on the same farm for 13 years gave the following example of how pesticides are used for general cleaning by stating that:

> "The dip of the animals are used to wash blankets [blankets used in the home] and it has a nice smell for fleas."
> (respondent 101)

This is a significant finding as each pesticide is registered for specific uses both for product efficacy purposes and for limiting exposure to safe levels and no pesticide is registered in South Africa for general cleaning purposes.[31]

[31] Despite conversations with relevant government officials and industry personnel, I am not clear how a household chemical claiming biocidal efficacy would be registered in South Africa. That is not to say that such claims are not regulated in South Africa; however, after some investigation, I am unaware of any

5.2.1.3 Perception of Pesticide Risks

In order to establish a consistent cognitive base across respondents, after the initial questions were asked assessing what respondents thought a pesticide was and what it was used for, the interviewers then told each respondent the same generic definition (see section 5.2.1.1) that pesticides were chemicals used to kill a variety of pests. Respondents were then asked their perception of pesticide risks (see Section C of questionnaire in Appendix A on Perceived Risks from Exposure to Pesticides). A considerable number of farm workers could not articulate their perception of pesticide risks. This became evident as the respondents struggled to answer questions on perceptions of danger and toxicity in relation to pesticides, as well as in ranking pesticide risks in relation to other risks in their social context.

In the first subsection of this section, specific perceptions and beliefs about "poisonous" will be presented (Subsection 5.2.1.3.a.); in the second subsection, beliefs and perceptions concerning "dangerous" and "poisonous" will be compared (Subsection 5.2.1.3.b.); in the final subsection, risks will be ranked (Subsection 5.2.1.3.c.).

5.2.1.3.a Assessing Poisonous

In assessing farm workers' risk perceptions related to pesticides, I first assessed how "poisonous" farm workers viewed pesticides to be in relation to other poisons in their social/cultural context. In previous research (Rother unpublished research, 2000), farm workers and small scale farmers were asked to list items they perceived to be

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cleaning agents which presently claim this. Although such household cleaners in the U.S. are registered as pesticides, the sense I have is that such products would not be registered as pesticides in South Africa unless they have an ingredient in them classified as a pesticide (e.g., fungicide). Presently, the only household cleaning products that are registered are disinfectants (South African Bureau of Standards Act 29 of 1993). These and other household agents (e.g., toilet cleaners) do not fall under the main pesticide act (Act 36 of 1947, see Table 2 in Chapter Two).

poisonous. This was an open-ended question where respondents' listed three items they thought were poisonous. This produced a long list of items. For the purpose of this study, the items that were cited by half or more of the respondents from the previous study were selected (see question B-1 in Appendix A and 16 items listed in Figure 12).

Farm workers in this study were asked whether they thought the items listed in Figure 12 were poisonous or not. Approximately 96 percent of respondents viewed both snakes and *Doom*[32] as poisonous, along with other common items (e.g., glue, canned fish tins, alcohol); while it might seem surprising that such a large percentage of respondents perceived fish tins as poisonous, in response to further investigation farm workers in the Western Cape (where fish is extensively consumed) indicated that these tins could make one very sick (i.e., food poisoning). Figure 12 illustrates that respondents were classifying both chemicals (*Doom*, pesticides, dips) and non-chemicals (snakes, fish tins) as poisonous. This figure, however, does not provide a "weighting" of each item listed in relation to one another (i.e., whether snakes are perceived as more poisonous than pesticides) as this was not the intention of the question.

5.2.1.3.b Dangerous versus Poisonous

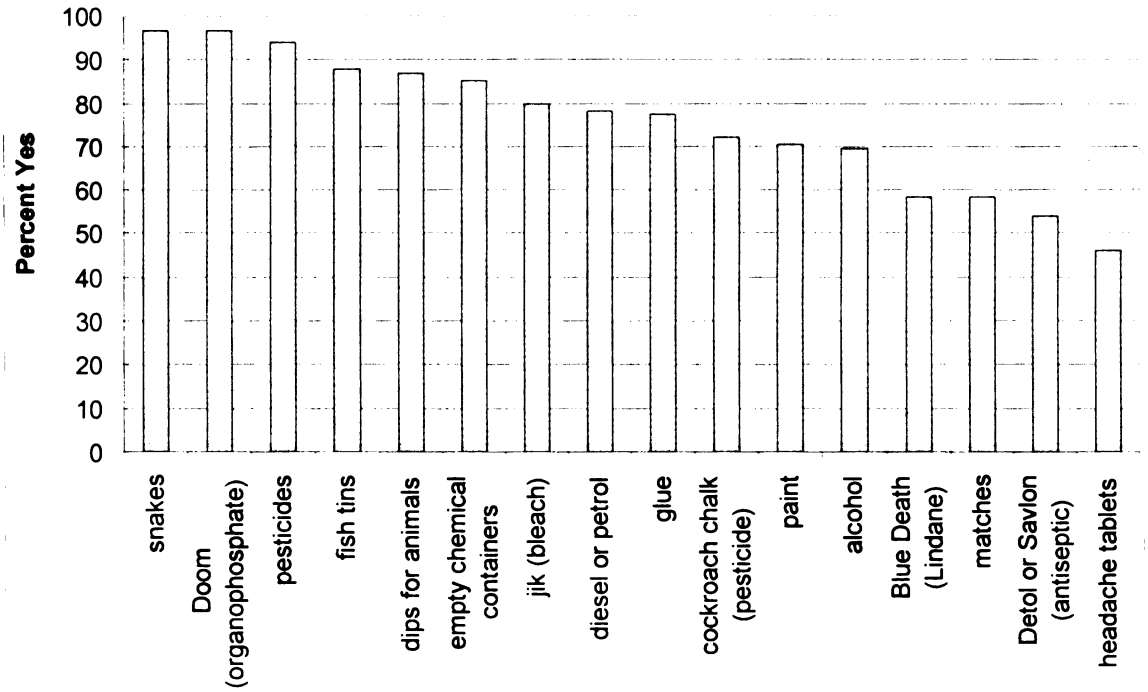
After ascertaining perceptions of poisonous, this research then attempted to assess whether the study respondents found a difference between pesticides being poisonous (*giftig*[33]) and pesticides being dangerous (*gevaarlik*) because of the different intended meanings of these two words on pesticide labels. The word "poisonous" is used on many

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[32] *Doom* is an organophosphate aerosol spray used for household insects and readily available in most shops in South Africa. *Doom* is found in a high percentage of households across wealthy and poor, as well as urban and rural, communities (Tolasana, S., unpublished research, 2003).

[33] Although there is a technical word for toxic in Afrikaans, farm workers were using *giftig* interchangeably to refer to toxic and poisonous (see focus group discussion in Chapter Four).

Figure 12: Farm Workers' Beliefs That the Following Are Poisonous
(N=115)



South African pesticide labels in relation to a human health outcome. For example, the label in Appendix B states: "Poisonous when absorbed through the skin, swallowed or inhaled." Many of the definitions for the pictograms used on pesticide labels (see Table 42, in Chapter Six) indicate that the pesticide is "dangerous" (e.g., the fish symbol, number 8 in Table 42 means "dangerous/harmful to fish & water bodies") indicating a potential negative outcome other than human health. According to the Oxford dictionary, poisonous is defined as a substance which, when introduced into or absorbed by a living organism, destroys life or injures health. Dangerous in turn is defined as unsafe, or causing liability or exposure to harm, risk or peril.

To assess whether farm workers perceived a difference in meaning between the two, respondents were asked, "Are all pesticides poisonous?" (question B-6 in Appendix A); and "Are all pesticides dangerous?" (question B-7 in Appendix A). Approximately

61 percent of respondents said all pesticides were poisonous and 71 percent replied all were dangerous; approximately 52 percent of respondents indicated that all pesticides are both dangerous and poisonous (see Table 8). When comparing dangerous with poisonous responses, 19 percent indicated that all pesticides are dangerous but not all are poisonous, whereas approximately nine percent of respondents indicated that all pesticides were poisonous but not all are dangerous (see Table 8). Generally, respondents found herbicides to be more dangerous than other "pesticides" (e.g., insecticides, fungicides), especially in relation to household pesticides (e.g., *Doom*, or *Target*[34]).

TABLE 8: Comparison Between Respondents' Perception of Pesticides as Poisonous and Dangerous

(N = 115)

Believe All Pesticides Are Dangerous		**Believe All Pesticides Are Poisonous (%)**		
		Yes	No	**TOTAL**
	Yes	52.2	19.1	71.3
	No	8.7	20.0	28.7
TOTAL		60.9	39.1	100.0

Although 39 percent of respondents felt not all pesticides were poisonous and 29 percent felt not all were dangerous, ascertaining what influenced respondents in deciding whether a pesticide was or was not poisonous/dangerous was not always straight forward (e.g., 6.1 percent of respondents did not know how they assessed whether pesticides were poisonous or dangerous or both even though they cited a difference). Those respondents who indicated that they engaged in a decision making process for assessing whether a pesticide is poisonous/dangerous or not, were then asked the following questions: "How do you know which pesticides are poisonous and which are not? (question B – 6.1 in

[34] *Target* is also a household insect spray sold which can be sold as either an organophosphate where it is yellow labeled or a pyrethroid where it is blue labeled.

Appendix A); and "How can you tell which pesticides are dangerous and which are not? (question B – 7.1 in Appendix A). Tables 9 (question B -- 6.1) and 10 (question B -- 7.1) list the categorization of the ethnographic data for the responses given, along with some examples of these responses.

TABLE 9: Factors Influencing Perception Whether a Pesticide Is Poisonous or Not (N=45)

	%
The Label or Particular Components of The Label • "it is shown on the label" • "it depends on what the label says" • "the skeleton meaning very toxic will indicate which is poisonous or not" • "red, blue, yellow color on the label" • "the written information like 'toxic' or 'harmful'" • "the number of PPE you must wear[35]"	66.7
Instructions From The Farm Owner or Foreman • "the farm owner will tell us which pesticide is poisonous or not"	15.6
Pesticide Uses • "there are certain pesticides that you spray for fruit to mature; these are not toxic" • "the ones giving color to grapes is not poisonous" • "pesticides are poisonous because you must spray vineyards and plants"	6.7
Causes Health Effects • "only when you have skin irritation is it toxic to you" • "can kill you" • "it depends on those that will negatively affect – those are the ones that are poisonous"	6.7
Physical Attribute of The Pesticide • "stronger smell means more toxic"	2.2
The Mode of Action • "systemic pesticide is not toxic cause animals can graze while you spray and nothing will happen to it. A contact substance kills immediately"	2.2
An Action Imposed On Farm Workers By Foreman • "because when we have to leave the field when it is being sprayed and the foreman tells us"	2.2
The Type of Pesticide • "the herbicide is very toxic but not the *Doom* or *Target*[36]"	2.2
Don't Know How To Tell	17.8

Categories are not mutually exclusive as respondents could provide more than one response.

[35] On pesticide labels (see Appendices B-E) what PPE one needs to use when using a particular pesticide is illustrated in pictograms. Depending on the active ingredient, PPE pictograms can be from one to several.

[36] *Doom* is an organophosphate household insecticide spray which is yellow color coded (second most toxic pesticide sold in South Africa). *Target* is both an organophosphate (yellow color coded) and pyrethroid (blue color coded) household insecticide spray.

TABLE 10: Factors Influencing Whether a Pesticide Is Perceived As Dangerous or Not

(N=33)

	%
The Label or Particular Components of The Label • "the label will tell you" • "red label; skull & cross bones (and no crosses)" • "the label will tell you – look at the precautions and warnings" • "color codes on the bottle or bag" • "some pesticide label shows that you can only spray today and leave outside tomorrow; I can bring in the plant."	48.5
Causes Health Effects • "some make you sick and others not" • "some pesticides when inhaled can cause death where others do not" • "some pesticides make you itch or you develop a rash" • "some pesticides are harmful to humans but not plants"	12.1
Pesticide Uses • "some pesticides are used on the fruit that is less dangerous" • "something you can clean with (e.g., *Jik*[37]) is not dangerous" • "when spraying for different things"	12.1
Instructions From The Farm Owner or Foreman • "the foreman tells us" • "the foreman tells use that the pesticides are more of less dangerous"	6.1
Physical Attribute of the Pesticide • "some pesticides are 'made on strong' (high concentration)" • "it depends on their toxicity"	6.1
Action By Farm Worker • "if you do not protect yourself, the pesticide can become dangerous"	3.0
Don't Know How to Tell	21.2

Categories are not mutually exclusive as respondents could provide more than one response.

The majority of respondents (66.7 percent) who reported an influence on their decision cited some aspect of the label as indicating to them whether the pesticide was poisonous or not (see Table 9). Thus their risk judgment was based on information they selected to influence their judgment (e.g., skull and cross bones; the signal word "toxic"; the color code red; PPE pictograms). However, 70 percent of the 67 percent citing the label for how they knew the pesticide was poisonous, did not cite any specific aspect of the label just replying "it is stated on the label" or "it is shown on the label" or "it depends on what it says on the label".

[37] *Jik* is the product name for bleach. As has been illustrated, some respondents confused pesticides with household cleaning products and thus used this assumption in assessing whether pesticides are dangerous or not.

Other farm workers used varying factors, not based on technological rational indicators, for assessing whether the pesticide was poisonous or not. For example, a 43 year old woman who worked for 11 years on the farm as the farm crèche "teacher", relied on what pesticides are used for in order to assess whether the chemical was poisonous or not in stating that:

> There are certain pesticides that you spray for fruit to mature. These are not poisonous.
> (respondent 075)

A 28 year old male who is a pesticide sprayman and drives a pesticide spray tractor relied on the pesticide's mode of action as an indicator of poisonous by stating that:

> A systemic pesticide is not poisonous because animals can graze while you spray and nothing will happen to it. A contact substance kills immediately.
> (respondent 087)

A 59 year old male, who has never worked with pesticides, relied on a tangible physical attribute of pesticides, smell, to assess whether a particular pesticide is poisonous or not:

> I can tell which pesticides are poisonous by the smell. Some pesticides have a much stronger smell – those are poisonous.
> (respondent 110)

Table 10 shows the ethnographic categories and illustrative statements when respondents were asked how they assessed which pesticides were dangerous and which were not (see question B—7.1 in Appendix A). Generally, the categories for deciding whether a pesticide was dangerous or poisonous were similar. However, the influence of the pesticide label on the assessment whether a pesticide was dangerous (48.5 percent) to respondents was lower than for assessing poisonous (approximately 67 percent). At the same time, some of the categories had higher percentages for assessing dangerous than poisonous (e.g. health effects, pesticide uses, pesticide attributes). Furthermore, slightly

more people did not know how to tell which pesticides were dangerous (21.2 percent) in comparison to which are poisonous (17.8 percent).

Farm workers presented other mental models, as well, for assessing whether a pesticide is dangerous or not. For example, a 40 year old woman, who had worked on the farm for 18 years, but never directly with pesticides, relied on the potency of the pesticide concentration to assess how dangerous the pesticide is:

> Some pesticides are "made on strong" [a strong concentration] and those are more dangerous than others.
> (respondent 099)

A 36 year old female, who had worked on the same farm for 15 years, but never worked with pesticides, relied on authority figures, such as the farm foreman, to make the decision for her as to whether a pesticide is dangerous or not by stating that:

> Some pesticides are used on the fruit that is less dangerous. The foreman tells us that the pesticides are more or less dangerous.
> (respondent 087)

5.2.1.3.c Pesticide Risk Ranking

In further assessing the understanding of poisonous, farm workers were asked to rank dirty water, headache tablets, pesticides and petrol in order of what they felt was most poisonous to least poisonous (question B-4 in Appendix A). Figure 13 illustrates that pesticides were seen as most poisonous followed by petrol and dirty water. Headache tablets were seen as the least poisonous in relation to the other hazards.

Respondents were also asked to rank pesticides in relation to other dangers common for farm workers (see Figure 14). When asked to rank smoking cigarettes,

Figure 13: Poisonous Ranking of Pesticides and Other Hazards (N=113)

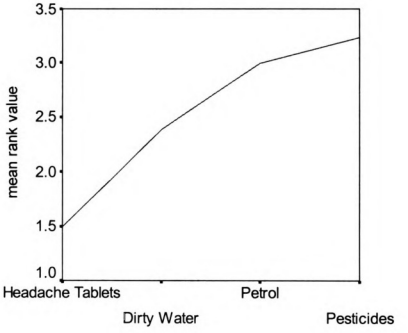
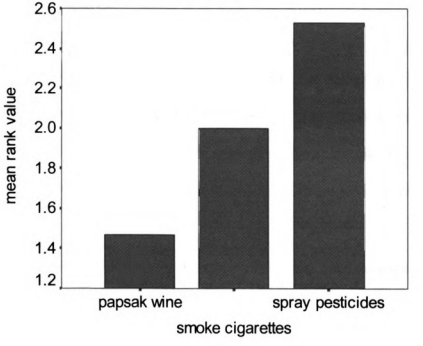


Figure 14: Dangerous Ranking of Hazards for Farm Workers (N=115)



drinking papsak[38] wine and spraying pesticides: Seventy percent of respondents ranked spraying pesticides as most dangerous; 60 percent ranked smoking cigarettes as second most dangerous; and 63 percent ranked drinking papsak wine as least dangerous for their health and safety.

To further assess farm workers' understandings of the word dangerous, study respondents were asked to rank the following three scenarios from most dangerous to least dangerous for their children's health and safety (question C—1.2 in Appendix A):

- The child breathing in someone else's cigarette smoke.
- The child swimming in a dam[39]
- The child playing in a field sprayed that morning with pesticides.

Study respondents ranked their children playing in a field with pesticides to be most dangerous for their children's health followed by passive smoking. Swimming in a dam was seen as the least dangerous for their children's health of the three (see Figure 15).

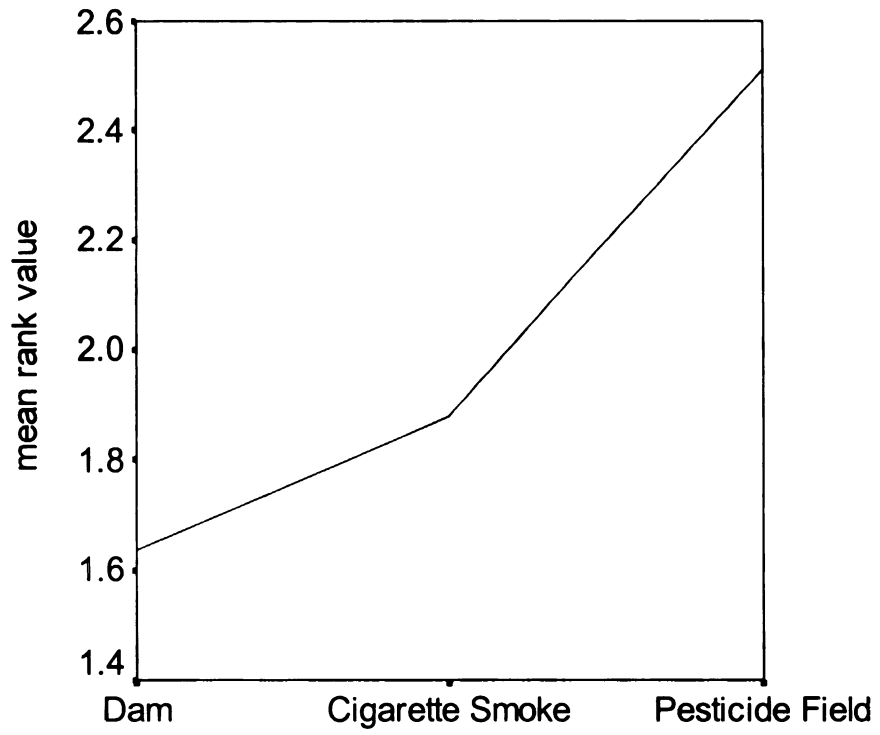
5.2.1.4 Health Effects

This section further presents the content of farm workers' risk perceptions by building on the findings of perceptions in relation to pesticides being dangerous and poisonous from the previous section and focusing on their perceptions of the health effects associated with pesticides. In the first subsection of this section on health effects, farm workers' perceived risks from exposure to pesticides are presented (Subsection

[38] *Papsak* wine is commonly drunk by farm workers in the Western Cape. It is a cheap low grade wine often made from the leftover low quality grapes; sold in bulk (e.g., 25 liters).

[39] Most farms in the Western Cape have their own dams on the farm. Every year many farm workers' children drown in these dams and thus it is identified as a hazard for farm worker families living on the farms.

Figure 15: Dangerous Ranking For Child's Health (N=115)



5.2.1.4.a.); and in the second subsection, farm worker's perceptions of chronic versus acute health affects are presented (Subsection 5.2.1.4.b.).

5.2.1.4.a Farm Worker's Perceived Risks From Exposures to Pesticides

The Health Belief Model provided the framework for analyzing questions that sought to understand farm workers' perceptions of their susceptibility to a risk outcome from exposure to pesticides. The Health Belief Model views risk behavior as a function of a person's subjective value of an outcome and his/her expectation that a particular health behavior will result in that outcome. Based on the questionnaire results, farm workers in the Western Cape had a high perception of risk from pesticide exposure for other farm workers (91.3 percent), for their own health (89.6 percent) and for their children (86.1 percent; see Table 11). Study respondents also had a high perception that

TABLE 11: Perceived Risk from Exposure to Pesticides (questions C-3; C-5; C-6; C-8; C-9 in Appendix A) (N=115)

Beliefs	Yes (%)	Don't Know (%)
Believe pesticides can harm co-worker's health	91.3	0.9
Believe pesticides can harm farm workers' own health	89.6	1.7
Believe pesticides can harm farm workers' children's health	86.1	0.0
Believe health of farm workers' unborn children hurt by pesticides	83.5	0.9
Believe farm workers' ability to have children hurt by pesticides	74.8	7.8

pesticides could affect the fetus of a farm worker (83.5 percent) and that pesticides could affect the fertility of farm workers (74.8 percent). Farm workers also were asked if all pesticides could make them sick. Almost three-quarters of the farm workers (69.6 percent) indicated that all pesticides could make them sick, while 30 percent felt that some would not make one sick. Table 12 illustrates the ethnographic categorization of

TABLE 12: Factors Influencing Farm Worker's Assessment of Which Pesticides Make Them Sick and Which Do Not (N = 32)

	%
The Label or Particular Components of The Label • "The label will indicate (tell/show) which one can make you sick or not[40]" • "On the label it is stated 'this one is more serious' or 'that one is less serious' " • "The label and the color will show" • "The red label will cause you to get sick; the yellow label is less dangerous"	43.8
Authority Figures • "It is indicated to the workers by the foreman" • "The foreman informs us and also the doctor will inform us in case we have a rash." • "The foreman tells us to get out." • "I do consulting with the owner about the type of pesticide and its effects" • "My mother tells me." • "The sprayer says its not dangerous – watery pesticides that has been sprayed"	21.9
Physical Attributes of Pesticides • "The smell of the pesticide will clearly indicate that it can make you sick or not."	3.1
Causes Health Effects • "Some can cause sickness because when such pesticides are sprayed, workers are not allowed in the field."	3.1
Don't K now How to Tell	28.1

Categories are not mutually exclusive as respondents could provide more than one response.

[40] One respondent mentioned the skull and cross bones as indicating this.

the responses the 30 percent of respondents gave on how they would assess which pesticides make them sick and which would not.

The responses in Table 12 indicate that many of these respondents (43.8 percent) are either influenced by the information on the pesticide label or assume the pesticide label provides information on which pesticides will make them sick and which will not. Furthermore, authority figures are a component in some farm workers' decision-making processes in regard to which pesticide will make them sick or not. Many respondents (28.1 percent) were unsure as to how they could tell which pesticides would make them sick and which would not.

Farm workers in the Western Cape had varying responses when asked what they thought are the possible health effects from pesticides for themselves and for their co-workers. The purpose of these questions was to assess what farm workers' perceptions of possible health effects were. Table 13 presents some of the responses to the question "If you are exposed to pesticides, what can happen to you?" (question C-4 in Appendix A). The results to this question were divided into two categories: health effects that the literature supports (see discussion in Chapter Two) as likely to be caused by pesticides (column A in Table 13) and health effects respondents identified that according to the literature are unlikely to be caused by pesticides for Western Cape farm workers (column B in Table 13).

Although pesticides can cause death, acute mortality from pesticides in the Western Cape is predominately from suicides. Data does not exist for chronic mortality related to pesticide exposure.[41] However, 74 percent of respondents replied that they

[41] As stated in Chapter Two, at present, it is very difficult to attribute non-acute mortality to pesticides as very little research has been conducted on the chronic effects of pesticide exposures, and because the

TABLE 13: Health Effects Cited by Respondents as Likely and Unlikely to be Caused by Pesticides

• skin irritations/rashes • chest/lung problems • headaches (feeling of vein bursting in head) • stomach pains • nausea & vomiting • paralysis • sweating • shortness of breath • tire easily • watery & itchy eyes • throat infected • dry throat • dizziness • burns skin • signs of a cold/flu (e.g., coughing) • face swells up	• diarrhea • symptoms of heart problems • allergic reactions • dermal allergic reactions • brain damage • coma • death (including suicides)[42] • eye problems/infections[43] • blindness[44] • tuberculosis • death (excluding suicides) • heart disease • weight loss • stiffness • infection (from germs)

could die if exposed to pesticides (see footnote 39 for an explanation as to why death is cited in both columns in Table 13). Three respondents believed they could contract TB from exposure to pesticides.

Farm workers had a high perception (97.4 percent) that they needed to protect themselves from pesticide exposures when asked "do you think you need to protect yourself from exposure to pesticides when working" (question C-7 in Appendix A). The range of reasons given for why respondents felt they needed to protect themselves could be grouped into seven categories. These are illustrated in Table 14, along with the percentage of respondents who gave a reason in that category.

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causes of death that can be chronic effects from pesticides may also result from contributing health factors experienced over time.

[42] Death was a difficult health effect to categorize, so it was placed in both categories. Although death can result from exposure to pesticides, this does not occur at a high rate in the Western Cape from acute exposure to pesticides. However, pesticide induced suicides are high. Deaths related to chronic exposures lack data and are undocumented.

[43] Farm workers in the Western Cape experience growths on the eye from exposure to the sun while working in the fields and commonly suffer from cataracts.

[44] Pesticides in very rare cases could cause blindness from neuro-optic damage or injury. However, this is very rare and unlikely to occur as frequently as expressed by several study respondents.

TABLE 14: Respondents' Rationales For Protecting Themselves From Pesticide Exposures

(N=112)

	%
Prevent Perceived Health Effects • "I can get sick." • "to prevent sickness/illness; cause of disease" • "to prevent pimples, skin outbreak, headaches" • "to ensure that the pesticide is not inhaled that causes TB" • "you can develop TB" • "because it can be inhaled and cause a burning chest" • "because you can die" • "To prevent blood poisonings (e.g., when you have a cut, pesticides can enter)" • "to prevent stomach pains" • "to prevent skin irritation and harm to skin." • "you can inhale it and you can die even if it is not immediately" • "dizzy; legs get weak"	73.2
Preventive Measures to Prevent Exposures and Routes of Entry in the Body • "Because if the wind blows that day it can cause the pesticide to blow into the person's face. If I am not wearing PPE the skin starts to itch and burn causing skin rash." • "to prevent inhalation" • "dangerous if you inhale it" • "to prevent contact with skin" • "can have negative effects when not wearing PPE such as lung problems and chest problems" • "so you don't get it in your body because you can get sick" • "contact with skin, eyes, mouth can cause illness" • "you can get sick when you inhale the pesticide or ingest it when you did not wash your hands after handling pesticides"	20.5
Self Preservation • "for your own safety" • "I want to uphold my health/to keep you healthy/to be healthy" • "I don't want to get sick because I need to protect my family and provide for them." • "I want to be well and live" • "to secure ones safety; to ensure one doesn't get sick" • "your responsibility to avoid getting sick"	15.2
Properties of Pesticides • "because the pesticide is dangerous" • "because pesticides are poisonous"	15.2
Prevent transmission • "can carry the sickness to the family at home" • "because it is dangerous and when you as the sprayer come in contact with someone else (e.g., child) then the child can inhale it" • "I will not go to the pesticide" • "safety of animals on farm" • "safety of farm workers" • "chemicals can stuck in clothes"	3.6

TABLE 14: (Continued):

	%
Previous Poisoning Incidents and Experiences • "with Worcester incident [where farm workers were poisoned by drinking pesticides] the farm owner has changed the protection of workers" • "because I work with poison and get sick"	1.8
Don't Know	3.6

Categories are not mutually exclusive as respondents could provide more than one response.

Although perceptions of potential effects of exposure are not always correct (e.g., TB or blood poisoning), the concept that an ill effect occurs from pesticide exposure exists widely among farm workers (see Table 14). Some farm workers had the belief that pesticides could be transmitted from one person or area to another and therefore they needed to protect themselves to prevent transmission of pesticides.

5.2.1.4.b Perceptions of Chronic versus Acute Health Effects

As indicated in the methodology chapter (Chapter Four), an unexpected outcome of the focus group was the distinction between acute and chronic health effects. It was unforeseen that farm workers would make a distinction between the two as legislation and pesticide training predominately focus on the more easily identifiable acute effects. However, the interview findings indicate that farm workers are making a distinction. More than three-fifths (66.1 percent) of farm workers indicated that not all pesticides can make you sick straight away (acute), while 90 percent reported that some pesticides can make one sick years from now (chronic). The farm workers were then asked "if some pesticide can make one sick now and some later, which pesticides are the worst for your health" (question C-12.1 in Appendix A); 38 percent replied those that make one immediately sick (acute) and 57 percent indicated the pesticides that make one sick in the future (chronic).

5.2.1.5. Routes of Exposure to Pesticides

Table 15 presents the findings of farm workers' perceptions in regard to pesticide exposure scenarios. Although there may have been respondent bias from answering several questions in a row about pesticides potentially causing health hazards, farm workers had a high perception that one can be exposed to pesticides from smoking or eating after spraying and before washing, as well as from breathing in pesticides which are in the air.

TABLE 15: How Do You Believe Farm Workers Can Come into Contact With Pesticides While Working?
(N=115)

(Question B-5 in Appendix A)	
	percent agree
By smoking or eating after spraying and before washing?	90.4
By breathing pesticides in the air?	89.6
By being sprayed with pesticides?	87.8
By wearing dirty (previously worn at work) overalls?	87.8
By eating plants from a sprayed field?	87.0
By walking bare legged or bare foot in sprayed field?	85.2
By touching crops or plants after pesticides have been applied?	85.2
By handling spray equipment?	82.6
By swallowing sweat off one's face?	81.7
When mixing, loading and applying pesticides?	81.7
By cleaning a drain?	78.3
By changing a light bulb?[45]	37.4

Categories are not mutually exclusive.

Intriguing outcomes resulted from the "throw-away questions" which were inserted into the question asked in Table 15 to reduce the effect of leading questions (Berg 2001). These questions are generally minor or unnecessary for collecting the relevant information required for the study. The purpose of the throw-away questions in

[45] Some respondents qualified this answer by stating bulbs in the spray tractors or bulbs in the pesticide store rooms.

this study was to distract/limit guessing and response bias (i.e., the respondent saying yes because the respondent thinks this is what the interviewer wants to hear). It was not intended that these questions would solicit significant information about exposure to pesticides. However, one throw-away question drew out crucial insights. The question asked was (see Table 15): "how do you believe farm workers can come into contact with pesticides while working?". In order to balance the list of suggested responses, the following two throw-away questions were inserted: "by changing a light bulb", and "by cleaning a drain". Surprisingly, 78 percent of respondents cited "by cleaning a drain" as a possible exposure scenario. The reason for this became evident later on in the questionnaire when 44 percent of respondents said they would dispose of pesticide wash water "in a drain". Hence, if farm workers believe that the pesticide wash water must be disposed of in a drain, then cleaning a drain would increase their exposure to pesticides[46].

5.2.1.6. Perception of Exposure Prevention

This section provides further results of the content of farm workers' risk perceptions by presenting the findings of perceptions in relation to how farm workers believe they can protect themselves from hazardous pesticide exposures. There was some variation in how farm workers felt they can protect themselves. One-third (34 percent) of respondents, two-thirds of whom were male (24 percent), said that they would wear or use Personal Protective Equipment (PPE). Many respondents were specific about the types of PPE they would use (e.g., overalls, gloves, top boots, rubber gloves, masks, raincoats), although not every arrangement cited would ensure full protection

[46] Generally, South African farm workers would clean a drain with their hands and not a drain cleaner.

(e.g., only gloves and no respirator). Table 18 (below) lists other measures respondents cited for protecting themselves against pesticide exposures.

When asked about the protection PPE provides, 81 percent of participating farm workers believed that PPE protects them from all possible pesticide health effects. This belief was almost equally high between male farm workers (82.4 percent) and females (80.4 percent). Furthermore, farm workers were asked if they would continue to work with pesticides if PPE were not available. Approximately 80 percent reported they would not work without PPE, which appears higher than is the case in practice, at least according to some indications (Schwab et al. 1995; Hanshi 2001; and the author's observations). Again, this belief was nearly equally shared between male respondents (84.1 percent) and female respondents (82.6 percent).

Setting aside the problem of response bias, Table 16 illustrates the ethnographic categorization of responses of why 17 percent of farm workers said they would continue working with pesticides even if they did not have PPE (three percent did not know). The decision to work with pesticides even when PPE is not available appears to be derived from personal judgments based on:

- farm workers' personal contexts and circumstances (e.g., "nothing has happened before"),
- farm workers' self-efficacy in that they believe they are able to successfully execute the behavior required to produce a protecting outcome (e.g., "I will wash afterwards"),
- authority figures' directives and power (e.g., "the boss tells us to work and we can't say no"; "the boss tells you to work in the area that has been sprayed"),
- economic barriers to precautionary behaviors (e.g., "I need the money"; "I want the job"),
- farm worker's interpretation and perception of pesticide characterization (e.g., "depends on how toxic it is"), and

- farm worker's social circumstances and contexts (e.g., "It is only the tractor drivers that get protective clothing, we don't get any"; "it is nothing new to work in such conditions").

TABLE 16: Farm Worker's Rationale for Continuing to Work With Pesticides When PPE is Not Provided
(N = 19)

	%
Personal Context and Circumstances • "Nothing has happened to me before" • "We don't wear it. They must give it if we ask, but we haven't asked for protective clothing." • "It is only the tractor drivers that have protective clothing; we don't get any" • "Have worked before without PPE – it was not available yet" • "It is nothing new to work in such conditions." • "I want the job."	31.6
Authority Figures • "The boss tells us to work with pesticides and we can't say no." • "The boss tells you to work in the area that has been sprayed." • "Only when informed that the pesticide being sprayed is not harmful." • "The owner provides soap to wash your hands after working with pesticides."	21.1
Perceived Barriers to Precautionary Action • "To complete the job. To get finished with the job and avoid delay." • "Need the money – you must buy your own protective clothing" • "I need the money so I would try, but it is not right." • "I won't then have food to eat. Must work to earn money."	21.1
Self-Efficacy • "I will just wash afterwards" • "Because I know I must work safely with the pesticide; I will still work with it." • "You can spray without gloves, but you must be careful not to touch the pesticide."	15.8
Perception of Pesticide Properties • "Depends on type of pesticide working with; some poisonous, some are not" • "Depends on how toxic the pesticide is."	10.5
Don't Know Why	5.3

Categories are not mutually exclusive as respondents could provide more than one response.

5.2.2. Background Influences on Perception of Pesticide Risks

This section presents the findings concerning factors that were suggested in the review of the literature as influencing farm workers' perception of pesticide risks (also see Figure 1 in Chapter One). These include: gender, education, age, training, occupational role, and previous poisoning incidents. In the literature, these six factors are highlighted as influencing perception, especially work related perceptions.

The eight beliefs (i.e., farm workers' pesticide risk perceptions) tested in relation to these factors were: (1) Believe that all pesticides are poisonous; (2) Believe that all pesticides are dangerous; (3) Believe that all pesticides can make farm workers sick; (4) Believe that pesticides harm farm workers' own health; (5) Believe that pesticides negatively affect fertility of the farm worker; (6) Believe that pesticide harm the fetus of an exposed mother; (7) Believe that pesticides harm the health of farm workers' children; and (8) Believe that pesticide harm co-workers' health. The eight beliefs were chosen for further analysis as they covered: (1) perception of pesticides themselves and whether farm workers believe that one can generalize about "all" pesticides (beliefs 1-3); (2) farm workers' perception of pesticides potential health effects to them personally (belief 4), to family members (e.g., children; belief 5), was well as to other non-family members (belief 8); and (3) farm workers' perception of pesticides ability to harm the unseen (fertility and a fetus) in the future.

5.2.2.1. Gender

Despite the particular and distinctive exposure risks women farm workers face (outlined in Chapter Two), males were more likely than women to believe that all pesticides are poisonous and dangerous, that all pesticides can make them sick, that pesticides harm their own health and that of their co-workers and their children, that pesticides affect the fertility of farm workers, and that pesticides harm the fetus of an exposed mother (see Table 17). The differences ranged from 21.8 percent to 5.8 percent, however only the differences in three beliefs out of the eight were significant at the .05 level (i.e., beliefs 3, 5, 6) and differences in two beliefs out of the eight were significant at the .10 level (e.g., beliefs 4 and 8).

TABLE 17: Relationship Between Gender and Perception

	Male n = 69 (%)	Female n = 46 (%)	Pearson's Chi-square P-value
Believe that all pesticides are dangerous	73.9	67.4	$\chi^2 = 0.57$ p = .449
Believe that all pesticides are poisonous	65.2	54.3	$\chi^2 = 1.37$ p = .242
Believe that all pesticides can make farm workers sick	78.3	56.5	$\chi^2 = 6.16$ p = .013
Believe that pesticides harm farm workers' own health	94.2	82.6	p = .063*
Believe that pesticides affect fertility of farm worker	81.2	65.2	$\chi 2 = 3.72$ p = .054
Believe that pesticides harm fetus of exposed mother	89.9	73.9	$\chi^2 = 5.09$ p = .024
Believe that pesticides harm the health of farm workers' children	88.4	82.6	$\chi^2 = 0.77$ p = .379
Believe that pesticides harm co-workers' health	95.7	84.8	p = .086*

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

Similarly, although the perception that farm workers needed to protect themselves from exposure to pesticides was generally high, it was slightly higher for males than females; all male respondents (100 percent) replied yes, whereas 94 percent of females agreed (Pearson's $\chi^2 = 4.62$; p=.032). The ethnographic data show that there is gender variation in relation to cautionary behavior, that is, pesticide protection measures differ between male and female farm workers (see Table 18). Females in the study focused on avoiding exposure to pesticides in relation to physical proximity to pesticide spraying activities. This was evident through responses such as standing further away from sprayers, leaving the field during spraying activities, making a distance detour when walking past sprayers or waiting until spraying is finished. On the other hand, males in

TABLE 18: Gender Variation on Exposure Protection Measures – Responses Given that Did Not Include Standard PPE Items (N = 112)

Female Responses	Male Responses
Self-Efficacy • To become safety aware • I will stand further away from the sprayers – like 3 or 4 rows • Walk a wide or a long distance from the people that are spraying • Leaving the field during spraying • I will stay away from pesticide when they are working with it. I will not go near where they spray • We turn our backs when the men are busy spraying. • You must wait after they have finished spraying and then you can work in that particular area (of the vineyard). • Usually waiting for a quiet time before working where pesticides have been sprayed	*Self-Efficacy* • be careful when you work with it
Preventative Measures • Put calamine lotion on my face • Cover mouth with a *lappie* (cloth) • Wash hands before you eat • Make sure hands are washed clean	*Preventative Measures* • Drink milk • Put Vaseline on my face so that the open areas of my face are covered, then wipe it off with a cloth • Wash hands after spraying • Wear "poison clothes" (*gif kler*) – fully protected and you don't sweat inside but poison cannot come onto your skin.[47] • Go see a doctor or clinic • Handle pesticides safely • Don't smoke or eat while working with pesticides
Precautionary Measures • Take precautions • To avoid it	*Precautionary Measures* • Only use amount of pesticide as prescribed on the label • Follow safety rules • Will not go in the pesticide room with out protection • Only use pesticides for that particular purpose

Categories are not mutually exclusive as respondents could provide more than one response.

[47] We were unable to figure out exactly what this was. It appears this was a homemade suit, not those generally provided by farmers. A big problem with PPE in the Western Cape is that the equipment is uncomfortable and hot. Consequently, many farm workers take off their PPE while spraying in the fields even though they are aware of the health effects. Thus the comment about this suit not making one sweat is of interest.

the study believed that they could protect themselves regardless of the degree of exposure, even if that protection is defined as going to the doctor.

The gendered variation in precautionary behavior was also evident in the gendered interpretation of what the purpose of the pesticide label is. However, the purpose of the label will be discussed further in Chapter Six. Almost four-fifths (77.3 percent) of male respondents pointed out that the pesticide label was for indicating what protective clothing must be worn, compared to only 23 percent of female respondents pointing out PPE on the label.

5.2.2.2. Education

In general, education is negatively related to believing that pesticides have harmful impacts; in six of the eight belief variables in Table 19, workers with low education are more likely to believe than more highly educated workers (i.e., beliefs 2-7), and on a seventh variable they are almost equal (i.e., belief 8). The difference in belief about all pesticides making workers sick and the effect on workers' fertility are significant at the .05 level, and the difference in belief that all pesticides are poisonous is almost significant at that level.

Of the study males, 68 percent fell into the low education category, compared to 46 percent of the study females (Pearson's χ^2 =5.76; p=.016). As gender is significantly related to education, one might wonder whether the findings about the effect of education on perception are actually due to gender and more specifically whether differences in beliefs about pesticides affecting fertility and all pesticides being poisonous and making sick are actually due to gender rather than education. However, as Table 19a shows, even when controlling for gender, a higher level of education is consistently associated with a

TABLE 19: Relationship Between Educational Level and Perception

	Low Education[1] n = 68 (%)	High Education[2] n=47 (%)	Pearson's Chi-Square P value
Believe that all pesticides are dangerous	61.0	68.1	$\chi^2 = 0.40$ p = .526
Believe that all pesticides are poisonous	67.6	51.1	$\chi^2 = 3.21$ p = .073
Believe that all pesticides can make farm workers sick	82.4	51.1	$\chi^2 = 12.9$ p = .000
Believe that pesticides harm farm workers' own health	92.6	85.1	p = .225*
Believe that pesticides affect fertility of farm worker	82.4	63.8	$\chi^2 = 5.06$ p = .025
Believe that pesticides harm fetus of exposed mother	85.3	80.9	$\chi^2 = 0.40$ p = .528
Believe that pesticides harm the health of farm workers' children	89.7	80.9	$\chi^2 = 1.82$ p = .177
Believe that pesticides harm co-workers' health	91.2	91.5	p = 1.00*

[1] "Low education" is defined as no formal education, didn't complete primary school and completed primary school.

[2] "High education" is defined as didn't complete secondary school, completed secondary school, and didn't complete tertiary education.

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

lower level of risk perception, although the difference is not statistically significant at the .05 level. Only the belief that all pesticides can make farm workers sick had a significant effect of education at the .05 level for both males (.05 significance level) and for females (nearly at the .05 level). The findings in Table 19a make clear that the effect of education on belief in impacts on workers' fertility is significant at the .05 level for females, and the

Table 19a: Influence of Educational Level on Perception Between Males and Females

	Low Education[1]		High Education[2]		Pearson's Chi-Square	
	Male n=47 (%)	**Female** n=21 (%)	**Male** n=22 (%)	**Female** n=25 (%)	**Male**	**Female**
Believe that all pesticides are dangerous	74.5	71.4	72.7	64.0	$\chi^2 = 0.02$ p = .878	$\chi^2 = 0.29$ p = .592
Believe that all pesticides are poisonous	72.3	57.1	50.0	52.0	$\chi^2 = 3.30$ p = .069	$\chi^2 = 0.12$ p = .727
Believe that all pesticides can make farm workers sick	87.2	71.4	59.1	44.0	p = .013*	$\chi^2 = 3.49$ p = .062
Believe that pesticides harm farm workers' own health	95.7	85.7	90.9	80.0	p = .587*	p = .710*
Believe that pesticides affect fertility of farm Worker	83.0	81.0	77.3	52.0	p =.742*	$\chi^2 = 4.22$ p =.040
Believe that pesticides harm fetus of exposed mother	91.5	71.4	86.4	76.0	p = .672*	p = .749*
Believe that pesticides harm the health of farm workers' children	89.4	90.5	86.4	76.0	p = .703*	p = .260*
Believe that pesticides harm co-workers' health	93.6	85.7	100	84.0	p = .546*	p = 1.00*

[1] "Low education" is defined as no formal education, didn't complete primary school and completed primary school.

[2] "High education" is defined as didn't complete secondary school, completed secondary school, and didn't complete tertiary education.

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

effect of education on belief in poisonous is almost significant at the .05 level for males. What the data is illustrating is that the relationship between education and perception of pesticides being poisonous is entirely due to males, and the relationship between education and perception of pesticides influencing fertility is almost entirely due to females. In addition, low education seems to "raise" females' perception of the negative

effects of pesticides on the health of their children to the point that it slightly exceeds the perception low education males have of that effect.

5.2.2.3. Age

Table 20 shows that age of farm worker plays virtually no role in variations of perceptions of pesticides as dangerous, poisonous, affecting a fetus, affecting the health of farm workers' children, and affecting the health of co-workers. However, Table 20

TABLE 20: Relationship Between Age and Perception

	Young (age 16-39) n=73 (%)	**Old (age 40-69)** n=42 (%)	**Pearson's Chi-Square P value**
Believe that all pesticides are dangerous	71.2	71.4	$\chi^2 = 0.00$ $p = .982$
Believe that all pesticides are poisonous	61.6	59.5	$\chi^2 = 0.05$ $p = .823$
Believe that all pesticides can make farm workers sick	64.4	78.6	$\chi^2 = 2.54$ $p = .111$
Believe that pesticides harm farm workers' own health	89.0	90.5	$p = 1.00^*$
Believe that pesticides affect fertility of farm worker	69.9	83.3	$\chi^2 = 2.57$ $p = .109$
Believe that pesticides harm fetus of exposed mother	83.6	83.3	$p = 1.00^*$
Believe that pesticides harm the health of farm workers' children	86.3	85.7	$\chi^2 = 0.08$ $p = .930$
Believe that pesticides harm co-workers' health	90.4	92.9	$p = .744^*$

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

does illustrate that the age of the farm worker could be an influence on perception that all pesticides make farm workers sick and perception of pesticides' possible influence on farm workers' ability to have children (i.e., fertility) at a .10 significance level. In both cases, older workers were more likely than younger workers to perceive pesticides as having the hazardous impacts.

Of the study males, 59 percent fell into the young age category compared to 70 percent of the study females in the young aged category (Pearson's χ^2 =1.23; p=.268). The findings illustrate that there is at most a weak relationship between age and gender, however it appears strong enough that one might wonder whether the findings about the effect of age on perception are actually due to gender, and more specifically whether differences in belief about fertility and about all pesticides causing sickness are actually due to gender rather than age.

In response to the question above, Table 20a illustrates that overall the effect of age on perception when controlling for gender is not due to gender. In fact, controlling for gender does not reveal any effects of age on perception that were not evident in the bivariate table (Table 20). However, in the case of belief about fertility and all pesticides causing sickness, there is a gender influence on the difference in beliefs for females for these two beliefs rather than an age difference. Table 20a also demonstrates that women generally, regardless of age, have a lower perception of pesticide related risks (although not significant differences) than both younger and older males.

Age is correlated with education; 54 percent of the younger farm workers and 11 percent of the older respondents had high levels of education (Pearson's χ^2 =23.0; p=.000). As age is related to education, we return to the findings in Table 19 where there

TABLE 20a: Relationship Between Age and Perception, Subdivided by Gender

		Young (age 16-39) (%)	Old (age 40-69) (%)	Pearson's Chi-Square P value
Believe that all pesticides are dangerous	**Male N=69**	73.2 (41)	75.0 (28)	$\chi^2 = 0.03$ p =.865
	Female N=46	68.8 (32)	64.3 (14)	p =1.00*
Believe that all pesticides are poisonous	**Male N=69**	65.9 (41)	64.3 (28)	$\chi^2 = 0.02$ p =.893
	Female N=46	56.3 (32)	50.0 (14)	$\chi^2 = 0.15$ p = .695
Believe that all pesticides can make farm workers sick	**Male N=69**	75.6 (41)	82.1 (28)	$\chi^2 = 0.42$ p = .518
	Female N=46	50.0 (32)	71.4 (14)	$\chi^2 = 1.82$ p = .177
Believe that pesticides harm farm workers' own health	**Male N=69**	95.1 (41)	92.9 (28)	p = 1.00*
	Female n=46	81.3 (32)	85.7 (14)	p = 1.00*
Believe that pesticides affect fertility of farm worker	**Male N=69**	80.5 (41)	82.1 (28)	$\chi^2 = 0.03$ p = .863
	Female n=46	56.3 (32)	85.7 (14)	p = .092*
Believe that pesticides harm fetus of exposed mother	**Male N=69**	90.2 (41)	89.3 (28)	p = 1.00*
	Female n=46	75.0 (32)	71.4 (14)	p = 1.00*
Believe that pesticides harm the health of farm workers' children	**Male N=69**	87.8 (41)	89.3 (27)	p = 1.00*
	Female n=46	84.4 (32)	78.6 (14)	p = .684*
Believe that pesticides harm co-workers' health	**Male N=69**	95.1 (41)	96.4 (28)	p = 1.00*
	Female n=46	84.4 (32)	85.7 (14)	p = 1.00*

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

was a relationship between age and fertility, and hence control for education in Table 20b to see if this relationship continues to hold.

TABLE 20b: Relationship Between Age and Perception, Subdivided by Educational Level

		Young (age 16-39) (%)	Old (age 40-69) (%)	Pearson's Chi-Square P value
Believe that all pesticides are dangerous	**Low Education n=68**	71.0 (31)	75.7 (37)	p = .784*
	High Education n=47	71.4 (42)	40.0 (5)	p =.309*
Believe that all pesticides are poisonous	**Low Education n=68**	74.2 (31)	62.2 (37)	p =.313*
	High Education n=47	52.4 (42)	40.0 (5)	p = .666*
Believe that all pesticides can make farm workers sick	**Low Education n=68**	77.4 (31)	86.5 (37)	$\chi^2 = 0.95$ p = .329
	High Education n=47	54.8 (42)	20.0 (5)	p = .188*
Believe that pesticides harm farm workers' own health	**Low Education n=68**	93.5 (31)	91.9 (37)	p = 1.00*
	High Education n=47	85.7 (42)	80.0 (5)	p = .571*
Believe that pesticides affect fertility of farm worker	**Low Education n=68**	80.6 (31)	83.8 (37)	$\chi^2 = 0.11$ p = .735
	High Education n=47	61.9 (42)	80.0 (5)	p = .640*
Believe that pesticides harm fetus of exposed mother	**Low Education n=68**	83.9 (31)	86.5 (37)	p = 1.00*
	High Education n=47	83.3 (42)	60.0 (5)	p = .240*
Believe that pesticides harm the health of farm workers' children	**Low Education n=68**	87.1 (31)	91.9 (37)	p = .694*
	High Education n=47	85.7 (42)	50.0 (5)	p = .134*

TABLE 20b (Continued):

		Young (age 16-39) (%)	Old (age 40-69) (%)	Pearson's Chi-Square P value
Believe that pesticides harm co-workers' health	**Low Education n=68**	90.3 (31)	91.9 (37)	p = 1.00*
	High Education n=47	90.5 (42)	100 (5)	p = 1.00*

Numbers in parentheses represent the n's for the subgroup in each cell for which the percentage was calculated.

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

When controlling for education, Table 20b reveals that the relationship between age and fertility, and age and all pesticides make sick (table 20) is not due to education. Despite insignificance, young farm workers with a high education level did not believe pesticides could affect farm worker's fertility in comparison to young low education farm workers and older farm workers with high and low education (see Table 20b). The apparent effect of age on perception of impact on fertility is largely due to highly educated young workers; it appears that, among young workers, belief in harm to fertility has been somewhat depressed by higher education. Also the visible effect of age on perception that all pesticides can make one sick is mostly due to older high education workers. That is, among older workers, belief that all pesticides make sick is to some extent reduced by lower education.

5.2.2.4. Occupational Role

In this study, it was hypothesized that the occupational role of the farm worker influences her/his pesticide risk perception. Respondents were asked about their present

occupation in their current employment. The breakdown for occupations is found in Table 21.

TABLE 21: Occupation/Job title

N =115

Question asked: What job are you currently doing?	(%)
1. Sprayman (includes spraying, mixing, sprayer driver)	34.7
2. Foreman or supervisor	8.7
3. General farm worker	73.0
4. Tractor driver or driver	30.4
5. Other[#]	6.4

[*] Many respondents have multiple jobs and therefore more than one category was marked.

[#] These were: training officer, crèche teacher, mechanic, restaurant worker, general cleaners and wire worker. This category has been deleted from the following tables as it is not a generalizable group to which one can make comparisons.

Despite there being no significance at even the .01 level for six of the eight beliefs (i.e., 1, 4-8), Table 22 demonstrates that foremen and supervisors have the lowest level of belief in comparison to the other occupation categories. Furthermore, for seven of the eight beliefs (i.e., 1, 3-8), eight of these 14 findings being significant at the 0.1 level, spraymen and tractor drivers have the highest levels of belief. For six of the eight beliefs (i.e., 1, 4-8), general workers' beliefs were in between foremen and supervisors at the low end and spraymen and tractor drivers at the high end; however only two of these six findings is close to significant at the 0.1 level .

Table 23 illustrates the educational status of farm workers in relation to their occupation compared to all other categories of workers. At the .01 significance level, tractor drivers were the least educated (22.9 percent) in comparison to spraymen, foremen and supervisors, and general workers, and spraymen were significantly less likely than general workers and foremen to have high education.

TABLE 22: Relationship Between Occupational Role and Perception

	Spraymen	Foremen	General Workers	Drivers
	n=40 (%)	**n=10** (%)	**n=84** (%)	**n=35** (%)
Believe that all pesticides are dangerous	82.5 $\chi^2 = 3.76$ p = .053	70.0 $\chi^2 = 0.01$ p = .924	70.2 $\chi^2 = 0.17$ p = .677	82.9 $\chi^2 = 3.28$ p = .070
Believe that all pesticides are poisonous	65.0 $\chi^2 = 0.44$ p =.507	70.0 $\chi^2 = 0.38$ p = .536	58.3 $\chi^2 = 0.84$ p = .842	62.9 $\chi^2 = 0.08$ p = .773
Believe that pesticides harm farm workers' own health	100 p = .008*	80.0 p = .279*	88.1 p = .509*	100 p = .017*
Believe that pesticides affect fertility of farm worker	82.5 $\chi^2 = 1.94$ p=.164	60.0 p=.269*	78.6 $\chi^2 = 2.37$ p=.124	85.7 $\chi^2 = 3.19$ p=.074
Believe that pesticides harm fetus of exposed mother	92.5 $\chi^2 = 3.62$ p = .057	70.0 p = 365	86.9 $\chi^2 = 2.65$ p = .103	91.4 $\chi^2 = 2.31$ p = .129
Believe that pesticides harm the health of farm workers' children	92.5 $\chi^2 = 2.11$ p = .147	80.0 p = .628*	86.9 p = .763*	88.6 p = .773*
Believe that pesticides harm co-workers' health	97.5 p = .161*	80.0 p = .210*	91.7 p = 1.00*	94.3 p = .721*

Categories of work were not mutually exclusive; respondents could do more than one of the listed work tasks.

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

Thus far Table 22 has highlighted that sprayers and drivers generally have a higher pesticide risk perception than general workers and foremen, and Table 23 revealed that sprayers and drivers generally have a low level of education. Since earlier in this

TABLE 23: Educational Status of Farm Workers in Relation to Occupation

	High Education (%)		n
Spraymen*	30.0	$\chi^2 = 3.00$ p=.083	40
Foremen/supervisors#	40.0	p=.615	10
General Workers*	39.3	$\chi^2 = 0.32$ p=.570	84
Tractor Drivers*	22.9	$\chi^2 = 6.76$ p=.009	35

Total N equals more than 115 as some respondents did more than one task on the farm.

*As categories are not mutually exclusive a Pearson's Chi-Square test was used to compare this category of work to all other categories of work combined.

#A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

section it was demonstrated that education is negatively related to pesticide risk perceptions, Table 24 presents whether the apparent effect of occupation on perception is really an effect of the farm workers' educational level.

In Table 22 sprayers and drivers had a higher belief than general farm workers for all eight beliefs. In Table 24, although the differences diminish some, low education spraymen and drivers have a higher belief than low education general farm workers on seven of the eight beliefs (i.e., 1-6 and 8). Similarly, high education sprayers and drivers have a higher belief than high education general farm workers on seven of the eight beliefs (i.e., 1-5; 7 and 8). In Table 24, low education sprayers and drivers have a higher belief than low education foremen on six of the eight beliefs (i.e., 1, 4-8); and high education sprayers and drivers have a higher belief than high education foremen on five of the eight beliefs (i.e., 2-6). For low education spraymen, the effect of occupation was statistically significant at nearly the .05 level for belief that pesticides harm a fetus and that pesticides are dangerous. Both high and low education spraymen have a significant belief, at the nearly .05 level, that all pesticides make farm workers sick. Despite the fact

that controlling for education diminishes some of the effect of occupation, sprayers and drivers' beliefs versus general farm workers still differed for six of the eight beliefs, even though not significant at even the .10 level. However, these six beliefs were not all the same as those in Table 22 (i.e., 1, 4-8 in Table 21 versus 1-5, 8 in Table 24).

TABLE 24: Perception in Relation to Occupation and Educational Level

		Spraymen (%)	Foremen (%)	General Workers (%)	Drivers (%)
Believe that all pesticides are dangerous	**Low Education n = 68**	85.7 $\chi^2 = 3.63$ p = .057 n = 28	66.7 p = .652* n = 6	72.5 p = 1.00* n = 51	77.8 $\chi^2 = 0.04$ p = .519 n = 27
	High Education n = 47	75.0 p = .725* n = 12	75.0 p = 1.00* n = 4	66.7 p = 1.00* n = 33	100 p = .042* n = 8
Believe that all pesticides are poisonous	**Low Education n = 68**	71.4 $\chi^2 = 0.31$ p =.577 n = 28	100 p = .166* n = 6	64.7 $\chi^2 = 0.81$ p = .369 n = 51	66.7 $\chi^2 = 0.20$ p = .888 n = 27
	High Education n = 47	50.0 $\chi^2 = 0.01$ p = .932 n = 12	25.0 p = .348* n = 4	48.5 $\chi^2 = 0.30$ p = .587 n = 33	50.0 p = 1.00* n = 8
Believe that all pesticides can make farm workers sick	**Low Education n = 68**	89.3 p = .334* n = 28	100 p = .581* n = 6	80.4 p = .716* n = 51	85.2 p = .751* n = 27
	High Education n = 47	75.0 $\chi^2 = 3.70$ p = .055 n = 12	50.0 p = 1.00* n = 4	48.5 $\chi^2 = 0.30$ p = .587 n = 33	75.0 p = .245* n = 8
Believe that pesticides harm farm workers' own health	**Low Education n = 68**	100 p =.073* n = 28	83.3 p =.379* n = 6	92.2 p =1.00* n = 51	100 p =.149* n = 27
	High Education n = 47	100 p =.033* n = 12	75.0 p =.488* n = 4	81.8 p =.657* n = 33	100 p =.329* n = 8

TABLE 24 (Continued):

		Spraymen	Foremen	General Workers	Drivers
Believe that pesticides affect fertility of farm worker	**Low Education n = 68**	85.7 p = .748* n = 28	66.7 p = .285* n = 6	84.3 p = .477* n = 51	85.2 p = .751* n = 27
	High Education n = 47	75.0 p = .492* n = 12	50.0 p = .613* n = 4	69.7 $\chi^2 = 1.65$ p = .199 n = 33	87.5 p = .228* n = 8
Believe that pesticides harm fetus of exposed mother	**Low Education n = 68**	96.4 p =.039* n = 28	66.7 p =.212* n = 6	88.2 p =.254* n = 51	92.6 p =.294* n = 27
	High Education n = 47	83.3 p =1.00* n = 12	75.0 p =1.00* n = 4	84.8 p =.419* n = 33	87.5 p =1.00* n = 8
Believe that pesticides harm the health of farm workers' children	**Low Education n = 68**	92.9 p =.691* n = 28	66.7 p =.112* n = 6	90.2 p =1.00* n = 51	85.2 p =.423* n = 27
	High Education n = 47	91.7 p =.412* n = 12	100 p =.574* n = 4	81.8 p =.100* n = 33	100 p =.323* n = 8
Believe that pesticides harm co-workers' health	**Low Education n = 68**	96.4 p =.389* n = 28	66.7 p =.084* n = 6	88.2 p =.325* n = 51	92.6 p = 1.00* n = 27
	High Education n = 47	100 p =.560* n = 12	100 p =1.00* n = 4	97.0 p =.073* n = 33	100 p =1.00* n = 8

*A Fisher's Exact Test was used to calculate the p-value as one or more cells contained less than five respondents. In each cell, the percentage is the portion of that occupational group expressing that belief, controlling for educational level; the Pearson's chi square or Fisher's exact statistic is computed for the presence or absence of belief among that occupational group in comparison with all other occupational groups combined, controlling for educational level; the n is the number of respondents in that occupational group with the indicated educational level.

Table 25 demonstrates the gender division of the on farm tasks. Significant results at the .05 level show that men are more likely than women to be spraymen and tractor drivers (see Table 25), while women are more likely to be general workers. Interestingly, however, significant findings revealed that 13 percent of female study

participants indicated that they sprayed pesticides in their current job (see Table 31) despite that only four percent of women claim to have the official title of spraywoman (see Table 25). That is, 11 percent of all study sprayers were women and 89 percent were males illustrating that females are more likely to spray pesticides than would be expected from their work title and in relation to what is likely expected from women.

TABLE 25: Relationship Between Occupation and Gender

	Female n=46 (%)	**Male n=69** (%)	**Pearson's Chi-Square P value**
Spraymen	4.3	55.1	χ^2=31.3 p=.000
Foremen/supervisors	4.3	11.6	χ^2=1.83 p=.177
General Workers	89.1	62.3	χ^2=10.1 p=.002
Tractor Drivers	0.0	50.7	χ^2=33.5 p=.000

Table 17 illustrated that generally male farm workers have higher risk perceptions based on the eight beliefs tested than females, and Table 22 indicated that occupation is related to pesticide risk perception; but Table 25 highlighted that there is a gender division of farm occupations. So one might ask to what extent the apparent relationship between occupation and perception is spurious and actually due to the effect of gender. Table 26 demonstrates that overall there is a gender effect which accounts for the relationship between perception and occupational role. Generally, males in all occupational roles had a higher perception than females in that occupation (excluding tractor drivers which were only males). Male sprayers perceived four of the eight beliefs higher than females (i.e., beliefs 1, 3, 5, 6), whereas females had three beliefs higher than males (i.e., beliefs 2, 7, 8); one belief had the same percentage (i.e., belief 4). Male

TABLE 26: Perception in Relation to Occupation and Gender

		Spraymen (%)	Foremen (%)	General Workers (%)	Drivers (%)
Believe that all pesticides are dangerous	**Male n=69**	84.2 $\chi^2 = 4.65$ p = .031 n = 38	75.0 p = 1.00* n = 8	74.4 $\chi^2 = 0.15$ p = .902 n = 43	82.9 $\chi^2 = 2.95$ p = .086 n = 35
	Female n=46	50.0 p = 1.00* n = 2	50.0 p = 1.00* n = 2	65.9 p = 1.00* n = 41	0.0 $\chi^2 = 0$ p = 0 n = 0
Believe that all pesticides are poisonous	**Male n=69**	63.2 $\chi^2 = 0.16$ p = .691 n = 38	87.5 p = .246* n = 8	60.5 $\chi^2 = 1.14$ p = .286 n = 43	62.9 $\chi^2 = 0.17$ p = .676 n = 35
	Female n=46	100 p = .493* n = 2	0.0 p = .203* n = 2	56.1 p = .648* n = 41	0. 0 $\chi^2 = 0$ p = 0 n = 0
Believe that all pesticides can make farm workers sick	**Male n=69**	86.8 $\chi^2 = 3.66$ p = .056 n = 38	87.5 p = .676* n = 8	76.7 $\chi^2 = 0.15$ p = .694 n = 43	82.9 $\chi^2 = 0.88$ p = .348 n=35
	Female n=46	50.0 p = 1.00* n = 2	50.0 p = 1.00* n = 2	58.5 p = .640* n = 41	0. 0 $\chi^2 = 0$ p = 0 n = 0
Believe that pesticides harm farm workers' own health	**Male n=69**	100 p = .036* n = 38	87.5 p = .396* n = 8	93.0 p = 1.00* n = 43	100 p = .054* n = 35
	Female n=46	100 p = 1.00* n = 2	50.0 p = .321* n =2	82.9 p = 1.00* n = 41	0. 0 $\chi^2 = 0$ p = 0 n = 0
Believe that pesticides affect fertility of farm worker	**Male n=69**	84.2 $\chi^2 = 0.52$ p = .473 n = 38	62.5 p = .167* n = 8	83.7 p = .535* n = 43	85.7 $\chi^2 = 0.96$ p = .326 n = 35
	Female n=46	50.0 p = 1.00* n = 2	50.0 p = 1.00* n = 2	73.2 p = .003* n = 41	0.0 $\chi^2 = 0$ p = 0 n = 0
Believe that pesticides harm fetus of exposed mother	**Male n=69**	94.7 p = .230* n = 38	62.5 p = .030* n = 8	95.3 p = .095* n = 43	91.4 p = .710* n = 35
	Female n=46	50.0 p = .458* n = 2	100 p = 1.00* n = 2	78.0 p = .103* n = 41	0. 0 $\chi^2 = 0$ p = 0 n = 0

TABLE 26 (Continued):

		Spraymen (%)	Foremen (%)	General Workers (%)	Drivers (%)
Believe that pesticides harm the health of farm workers' children	**Male n=69**	92.1 p = .452* n = 38	75.0 p = .230* n = 8	88.4 p = 1.00* n = 43	88.6 p = 1.00* n = 35
	Female n=46	100 p = 1.00* n = 2	100 p = 1.00* n = 2	85.4 p = .203* n = 41	0. 0 $\chi^2 = 0$ p = 0 n = 0
Believe that pesticides harm co-workers' health	**Male n=69**	97.4 p = .584* n = 38	75.0 p = .034* n = 8	93.0 p = .285* n = 43	94.3 p = .572* n = 35
	Female n=46	100 p = 1.00* n = 2	100 p = 1.00* n = 2	94.9 p = .020* n = 41	0. 0 $\chi^2 = 0$ p = 0 n = 0

*A Fisher's Exact Test was used to calculate the p-value as one or more cells contained less than five respondents.

foremen and supervisors had five beliefs (i.e., beliefs1-5) out of the eight higher than females (i.e., beliefs 6-8). However, the largest difference was between male general workers who had seven beliefs (i.e., beliefs 1-7) out of eight higher than females, who had only one (i.e., belief 8).

Table 27 presents the distribution of study participants' job tasks in relation to pesticide usage. In terms of exposure assessment, more farm workers spray pesticides (48 percent) than conduct other exposure related tasks.

TABLE 27: Work Experience with Pesticides in Present Job (N = 115)

	(%)
Spray pesticides	47.8
Mix pesticides	37.4
Handle pesticides	33.0
Drive spray tractors	33.9
Clean clothing or spray equipment used for pesticides	32.2
Any of the above tasks	51.3

In Table 21, 35 percent of respondents indicated that their present job was a "sprayman" which included spraying, handling and mixing of pesticides; 38 were males and 2 females. However, in Table 27, a higher percentage of respondents indicated that they sprayed (47.8 percent) or mixed (37.4 percent), and almost as many (33.0 percent) indicated that they handled pesticides in their present job. What the study findings seem to highlight is that more people are conducting hazardous work than is indicated by the occupational data.

Table 28 further illustrates the relationship between occupation and working with pesticides. The main significant difference at the .10 level is that general workers are nearly evenly divided between those who work with pesticide and those who do not.

TABLE 28: Relationship Between Occupation and Working with Pesticides (N = 115)

	Work With Pesticides[@] (%)	Do Not Work With Pesticides (%)	Pearson's Chi-Square P value
Spraymen	95.0	5.0	$\chi^2 = 46.9$ $p = .000$
Foremen or Supervisors	40.0	60.0	$p = .521^*$
General Workers	46.4	53.6	$\chi^2 = 2.97$ $p = .085$
Tractor Drivers	97.1	2.9	$\chi^2 = 42.3$ $p = .000$

[@] Working with pesticides covered the tasks of spraying or mixing pesticides, driving spray tractors, cleaning clothes or equipment and handling pesticides.

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

Table 29 highlights that the belief of farm workers who conduct any on farm tasks involving pesticides is not significantly different from other workers' belief that all pesticides are dangerous, poisonous, all make farm workers sick or affect fertility. However, there was a significant finding for farm workers who did any task with

TABLE 29: Relationship Between Any Pesticide Related Task and Perception (N = 115)

	Work With Pesticides[a] (n=59) (%)	Do Not Work With Pesticides (n=56) (%)	Pearson's Chi-Square P value
Believe that all pesticides are dangerous	71.2	71.4	$p = 1.00^*$
Believe that all pesticides are poisonous	61.0	60.7	$p = 1.00^*$
Believe that all pesticides can make farm workers sick	74.6	64.3	$\chi^2 = 1.44$ $p = .231$
Believe that pesticides harm farm workers' own health	96.6	82.1	$\chi^2 = 6.43$ $p = .011$
Believe that pesticides affect fertility of farm worker	76.3	73.2	$\chi^2 = 0.14$ $p = .706$
Believe that pesticides harm fetus of exposed mother	88.1	78.6	$\chi^2 = 1.91$ $p = .167$
Believe that pesticides harm the health of farm workers' children	91.5	80.4	$\chi^2 = 2.99$ $p = .084$
Believe that pesticides harm co-workers' health	98.3	83.9	$p = .007^*$

[a] Working with pesticides covered the tasks of spraying or mixing pesticides, driving spray tractors, cleaning clothes or equipment and handling pesticides.

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

pesticides in that they had a high belief that pesticides could affect their co-workers' health and a high belief that pesticides could affect the worker's own health, both significant at the .05 level. Farm workers who work with pesticides had a nearly significant belief, at the .05 level, that pesticides harm farm workers' children and a nearly significant belief, at the .10 level, that a fetus can be harmed by pesticides (see Table 29).

Based on the results of Table 28 that general farm workers were nearly evenly split in terms working with and not working with pesticides, Table 30 looks at what effect this split has on general workers' perception. As is to be expected based on the literature, general farm workers working with pesticides had a higher risk perception for most of the eight beliefs (i.e., beliefs 2-4, 6-8)

Table 31 illustrates the gender division of the different on farm work tasks that involve in one way or another using or being exposed to pesticides in the work context.

Table 32 presents whether gender accounts for the differences in perception between those farm workers working with pesticides and those who do not highlighted in Table 29. In Table 29 there are three significant relationships (i.e., beliefs 4, 7 and 8) and one partially significant relationship (i.e., belief 6). Thus the question is whether gender accounts for any of these four relationships. Incidentally, Table 32 illustrates that only one of the four significant and quasi-significant relationships accounts for a gender difference; that is belief six. In the other three beliefs (i.e., beliefs 4, 7, 8), the difference is almost entirely due to males. That is, working with pesticides does not heighten the risk perception of females.

TABLE 30: Relationship Between Occupational Role and Perception

	Spraymen n=40 (%)	Foremen n=10 (%)	General Workers n=84 (%) work with pesticides	General Workers n=84 (%) don't work with pesticides	Drivers n=35 (%)
Believe that all pesticides are dangerous	82.5 $\chi^2 = 3.76$ p = .053	70.0 $\chi^2 = 0.01$ p = .924	66.7	73.3	82.9 $\chi^2 = 3.28$ p = .070
Believe that all pesticides are poisonous	65.0 $\chi^2 = 0.44$ p = .507	70.0 $\chi^2 = 0.38$ p = .536	59.0	57.8	62.9 $\chi^2 = 0.08$ p = .773
Believe that all pesticides can make farm workers sick	85.0 $\chi^2 = 6.90$ p = .009	80.0 p = .721*	71.8	64.4	82.9 $\chi^2 = 4.20$ p = .040
Believe that pesticides harm farm workers' own health	100 p = .008*	80.0 p = .279*	94.9	82.2	100 p = .017*
Believe that pesticides affect fertility of farm worker	82.5 $\chi^2 = 1.94$ p = .164	60.0 p = .269*	76.9	80.0	85.7 $\chi^2 = 3.19$ p = .074
Believe that pesticides harm fetus of exposed mother	92.5 $\chi^2 = 3.62$ p = .057	70.0 p = .365	94.9	80.0	91.4 $\chi^2 = 2.31$ p = .129
Believe that pesticides harm the health of farm workers' children	92.5 $\chi^2 = 2.11$ p = .147	80.0 p = .628*	94.9	80.0	88.6 p = .773*
Believe that pesticides harm co-workers' health	97.5 p = .161*	80.0 p = .210*	97.4	86.7	94.3 p = .721*

Categories of work were not mutually exclusive; respondents could do more than one of the listed work tasks.

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

TABLE 31: Gender Division of Work Experience

	Female n=46 (%)	Male n=69 (%)	Pearson's Chi-Square P value
Spray pesticides	13.0	71.0	χ^2=39.1 p=.000
Mix pesticides	4.3	59.4	χ^2=37.3 p=.000
Drive spray tractors	0.0	56.5	χ^2=40.9 p=.000
Clean pesticide clothing or spray equipment	8.7	47.8	χ^2=20.6 p=.000
Any other handling of pesticides	8.7	49.3	χ^2=21.8 p=.000
Any of the above tasks	13.0	76.8	χ^2=44.9 p=.000

TABLE 32: Relationship Between Any Pesticide Related Task and Perception Amongst Males and Females

		Work With Pesticides@ (%)	Do Not Work With Pesticides (%)	Pearson's Chi-Square P value
Believe that all pesticides are dangerous	**Male n=69**	73.6 n=53	71.0 n=16	p = 1.00*
	Female n=46	50.0 n=6	70.0 n=40	p = .375*
Believe that all pesticides are poisonous	**Male n=69**	60.4 n=53	81.3 n=16	χ^2 =2.36 p = .124
	Female n=46	66.7 n=6	52.5 n=40	p=.673*
Believe that all pesticides can make farm workers sick	**Male n=69**	79.2 n=53	75.0 n=16	p = .736*
	Female n=46	33.3 n=6	60.0 n=40	p = .380*
Believe that pesticides harm farm workers' own health	**Male n=69**	98.1 n=53	81.3 n=16	p=.036*
	Female n=46	83.3 n=6	82.5 n=40	p = 1.00*
Believe that pesticides affect fertility of farm worker	**Male n=69**	79.2 n=53	87.5 n=16	p=.717*
	Female n=46	50.0 n=6	67.5 n=40	p = .405*
Believe that pesticides harm fetus of exposed mother	**Male n=69**	90.6 n=53	87.5 n=16	p=.660*
	Female n=46	66.7 n=6	75.0 n=40	p = .644*

TABLE 32 (Continued):

		Work With Pesticides[@] (%)	Do Not Work With Pesticides (%)	Pearson's Chi-Square P value
Believe that pesticides harm the health of farm workers' children	**Male n=69**	92.5 n=53	75.0 n=16	p=.077*
	Female n=46	83.3 n=6	82.5 n=40	p = 1.00*
Believe that pesticides harm co-workers' health	**Male n=69**	98.1 n=53	87.5 n=16	p = .132*
	Female n=46	100 n=6	82.5 n=40	p=.348*

[@] Working with pesticides covered the tasks of spraying or mixing pesticides, driving spray tractors, cleaning clothes or equipment and handling pesticides.

* A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

5.2.2.5. Training as a Predictor Variable

A hypothesis in this research was that various forms of pesticide training (e.g., formal sessions, posters, video/TV, radio, books) would influence farm workers to have a higher pesticide risk perception than they would have without training. Farm workers were asked if they had ever received information or training on how to prevent or reduce their exposure to pesticides; 35 percent indicated that they had. It is important to mention here the validity of the measure "training" and that it is a somewhat fragile measure. That is, on the one hand workers may have received general information or training about pesticides, including about the risks and hazards of pesticide, without having received information or training about options to prevent or reduce exposures. Whereas, on the other hand, a worker may have received information or training about options to prevent or reduce exposure without out the information having been informative (e.g., wear PPE, read and follow the label). Consequently the variable is not a robust measure. However, training is an influencing measure but there is no justification for believing a prior that this variable is biased one way or another.

Overall those farm workers that received training had a higher pesticide risk perception than those who had not received training; this was the case for all eight of the belief variables. Only for the belief that pesticides harm the fetus of the exposed mother was there a significant difference at the .05 level (see Table 33). However, the

TABLE 33: Relationship Between Training and Perception (N = 114)

	Received Information or Training n=40 (%)	Never Received Information or Training n=74 (%)	Pearson's Chi-Square P Value
Believe that all pesticides are dangerous	75.0	70.3	$\chi^2 = 0.29$ $p = .592$
Believe that all pesticides are poisonous	65.0	59.5	$\chi^2 = 0.34$ $p = .562$
Believe that all pesticides can make farm workers sick	77.5	66.2	$\chi^2 = 1.58$ $p = .209$
Believe that pesticides harm farm workers' own health	90.0	89.2	$p = 1.00^*$
Believe that pesticides affect fertility of farm worker	85.0	70.3	$\chi^2 = 3.04$ $p = .081$
Believe that pesticides harm fetus of exposed mother	92.5	78.4	$\chi^2 = 3.73$ $p = .054$
Believe that pesticides harm the health of farm workers' children	92.5	83.6	$\chi^2 = 2.18$ $p = .140$
Believe that pesticides harm co-workers' health	97.5	87.8	$p = .162^*$

* A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

relationship between training and belief that pesticides can affect fertility was significant at the .10 level, and the effects of training on beliefs that pesticides can harm farm workers' children, and co-workers, were nearly significant at the .10 level.

Table 34 shows that there is a relationship between pesticide training and occupational role as hypothesized. Significant findings revealed that general farm workers were the occupational group least likely to receive pesticide training in comparison to spraymen, foremen/supervisors, and spray tractor drivers.

TABLE 34: Relationship Between Training and Occupational Role

	Received Information or Training (%)		n
Sprayman	53.8	χ^2=9.16 p = .002	40
Foreman or Supervisor	60.0	χ^2=2.99 p=.084	10
General Farm Worker	28.6	χ^2=5.95 p=.015	84
Tractor Driver or Driver	68.6	χ^2=24.9 p=.000	35

Chi-square was calculated for each occupational role in comparison to all three other roles.

Table 35 illustrates that 27 percent of farm workers working with pesticides received some form of training or information, compared to 24 percent who work with

TABLE 35: Relationship Between Training and Work Task
(N = 114)
(%)

	Received Training	**Received No Training**	**Total**
Work With Pesticides	27.2	23.7	50.9
Don't Work With Pesticides	7.9	41.2	49.1
Total	35.1	64.9	100

pesticides but never have received any training or information. Of the 35 percent of study respondents who received training, only 27 percent worked with pesticides.

Table 36 presents the data of the four apparent relationships between training and perception highlighted in Table 33 (i.e., beliefs 5-8) and highlights whether occupation is

TABLE 36: Perception in Relation to Occupation and Training

		Received Training (%)	Never Received Training (%)	Pearson's Chi-Square P value
Believe that pesticides affect fertility of farm worker	**Sprayman**	90.5 n=21	77.8 n=18	p = .387*
	Foreman	50.0 n=6	75.0 n=4	p = .571*
	General Worker	87.5 n=24	75.0 n=60	$\chi^2 = 1.59$ p = .207
	Tractor Driver	91.7 n=21	72.7 n=11	p = .297*
Believe that pesticides harm fetus of exposed mother	**Sprayman**	100 n=21	83.3 n=18	p = .089*
	Foreman	66.7 n=6	75.0 n=4	p = 1.00*
	General Worker	100 n=24	81.7 n=60	p = .029*
	Tractor Driver	91.7 n=24	90.9 n=11	p = 1.00*
Believe that pesticides harm the health of farm workers' children	**Sprayman**	90.5 n=21	94.4 n=18	p = 1.00*
	Foreman	83.3 n=6	75.0 n=4	p = 1.00*
	General Worker	95.8 n=24	83.3 n=60	p = .166*
	Tractor Driver	87.5 n=24	90.9 n=11	p = 1.00*
Believe that pesticides harm co-workers' health	**Sprayman**	95.2 n=21	100 n=18	p = 1.00*
	Foreman	83.3 n=6	75.0 n=4	P =1.00*
	General Worker	95.8 n=24	95.8 n=60	p = .667*
	Tractor Driver	95.8 n=24	90.9 n=11	p = 1.00*

*A Fisher's Exact Test was used to calculate the p-value as one or more cells contained less than five respondents.

responsible for this relationship. The findings in Table 36 show that for spraymen, training makes a difference for two of the four beliefs (i.e., 1 and 2). For tractor drivers, training makes a difference for two of the four beliefs (i.e., 1 and 2). For general workers, training makes a difference on three of the four beliefs (i.e., 1-3). For foremen and supervisors the difference training makes is not clear since the sample size is so small. Of the results in Table 36, three of the findings are significant at the 0.1 level or better. However, generally, occupation did not account for the association between training and occupation that occurred in Table 33.

As it is perceived that women's work tasks are a low source of exposure to pesticides, women are generally not trained about (i.e., given any information in regard to) pesticide safety and health issues. In this study 53 percent of males had received pesticide information or training in relation to health and safety issues (see Table 37). Contrasting with this, only 9 percent of female study participants had received any pesticide information or training (see Table 37). Given the significant relationship between gender and training, the question arising is whether the apparent relationship between training and belief in regard to the fetus, fertility, farm worker's children and co-workers (beliefs 5-8; see Table 33) is a true relationship or is it spurious and actually

TABLE 37: Relationship Between Gender and Training

Question D – 1 (Appendix A): Have you ever received any information or training?

	Male n = 68 (%)	**Female n = 46** (%)	
Received information or training	52.9	8.7	χ^2=23.6 p=.000

due to the co-variation with gender. Table 38 illustrates that for males, in general, the relationship between training and belief is greatly reduced. Conversely, for females the effect of training on belief appears very strong, but the sample size is small.

TABLE 38: Gender Influence on the Relationship Between Training and Perception

		Received Information or Training (%)	Never Received Information or Training (%)	Pearson's Chi-Square P value
Believe that pesticides affect fertility of farm worker	**Male n=69**	83.3 n=36	81.3 n=32	$\chi^2 = 0.05$ p=.822
	Female n=46	100 n=4	61.9 n=42	p = .282*
Believe that pesticides harm fetus of exposed mother	**Male n=69**	91.7 n=36	87.5 n=32	p = .699*
	Female n=46	100 n=4	71.4 n=42	p = .284*
Believe that pesticides harm the health of farm workers' children	**Male n=69**	91.7 n=36	84.4 n=32	p = .460*
	Female n=46	100 n=4	81.0 n=42	p = 1.00*
Believe that pesticides harm co-workers' health	**Male n=69**	97.2 n=36	93.8 n=32	p = .699*
	Female n=46	100 n=4	83.3 n=42	p = .560*

* A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

5.2.2.6. Influence of Personal Context Experience on Perception

This sub-section looks at the influence of having been made sick by pesticides (self identified by respondents) on the eight beliefs and whether this previous experience influences perception. Only 25 percent of respondents indicated that had been previously become sick from pesticides. Table 39 compares the findings of the respondents' beliefs for the eight beliefs in relation to the responses of those who had previously been made sick by pesticides. The findings in this table highlight that seven

TABLE 39: Influence of Personal Context of Having Previously Been Made Sick by Pesticides on Perception

	Yes (N = 115) %	No (N = 115) %	Ever Made Sick (N = 29) %	Never Made Sick (N = 86) %	
Believe that all pesticides are dangerous	71.3	28.7	86.2	66.3	$\chi^2 = 4.21$ p = .040
Believe that all pesticides are poisonous	60.9	39.1	79.3	54.7	$\chi^2 = 5.54$ p = .019
Believe that all pesticides can make farm	69.6	30.4	75.9	67.4	p = .487*
Believe that pesticides harm farm workers' own health	89.6	10.4	93.1	88.4	p = .728*
Believe that pesticides affect fertility of farm worker	74.8	25.2	75.9	74.4	$\chi^2 = 0.02$ p = .877
Believe that pesticides harm fetus of exposed mother	83.5	16.5	82.8	83.7	p = 1.00*
Believe that pesticides harm the health of farm workers' children	86.1	13.9	86.2	86.0	p =1.00*
Believe that pesticides harm co-workers' health	91.3	8.7	96.6	89.5	p = .448*

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

of the eight beliefs (i.e., beliefs 1-5 and 7, 8) had a higher belief result (i.e., an increase ranging from 0.1 to 18.4) for respondents previously made sick by pesticides. In comparing those respondent's beliefs with those who had ever been made sick and those who had not, only two differences were significant at the .05 level (i.e., beliefs 1 and 2).

5.3. DISCUSSION OF RESULTS

The literature review in Chapter Three highlighted that there are multiple dimensions to risk perception. The qualitative and quantitative findings of this study draw attention to some of the relevant dimensions influencing South African farm workers' risk perceptions (e.g., the social and cultural framing effects on their perceptions). These dimensions are discussed below under the following two subsections: the content of perception of pesticides (Section 5.3.1), and the background influences on perception of pesticide risks (Section 5.3.2).

5.3.1. Discussion of Content of Perception of Pesticides

The study findings show that participating South African farm workers generally had a high perception of pesticide risks to themselves (e.g., their own health, their fertility) and to their children (i.e., both a fetus and their children's health). As to be expected from the literature, overall farm workers had an even higher perception of risk from pesticide exposures to their co-workers then to themselves or their children. That is, farm workers' perceive that their co-workers are more at risk from negative impacts from pesticides than to themselves or their children, because as illustrated in the Health Belief Model, farm workers have a high self-efficacy in their ability to protect themselves and their children.

Farm workers were more likely to believe that pesticides were more dangerous (71.3 percent) than poisonous (60.9 percent), despite the facts that (1) the word "poisonous" is used on pesticide labels to refer to potential negative health outcomes and (2) the word "poisonous" translates into Afrikaans as "*giftig*" (poison translates to *gif*) and the colloquial word in Afrikaans for pesticides is "*Gif*" or "*Gifstowwe*". It is unclear

exactly why there is a 10 percent variation in the view between pesticide being poisonous and dangerous (also see Table 8). An assumption is that the word danger (*gevaar*) has a more severe connotation than poisonous. This would be an area to further research.

A high percentage of farm workers cited the pesticide label as influencing their perceptions of pesticides being poisonous (66.7 percent) and/or dangerous (48.5 percent), as well as for knowing which pesticides will make them sick (43.8 percent). Also, farm workers in this study generally had a very high perception (97.4 percent) that they needed to protect themselves from exposure to pesticides. The pesticide label as an authority influence and perception of protection are further discussed below. Overall, participating farm workers had high pesticide risk perceptions.

5.3.1.1. Pesticide Risk Perceptions – Conceptualization of Pesticides

This subsection on how farm workers in the Western Cape of South Africa conceptualized pesticides is broken into three further subsections: (1) How workers' conceptualize pesticides in comparison with South African law; (2) How workers' conceptualization reflects the use and function of pesticides; and (3) How workers' conceptualization of pesticides potentially affects safety behaviors.

5.3.1.1.a Workers' Pesticide Conceptualizations Compared to Legal References

Participating farm workers were confused with regard to whether a particular chemical or product was actually a pesticide (see Tables 5 and 6). Table 6 illustrated that 27 of study respondents correctly identified which substances were pesticides, whilst 46 percent of respondents had correctly identified which substances were not pesticides.

This demonstrates that respondents have a better understanding of what is not a pesticide than correctly identifying what is. The word "pesticide" is generally used in the scientific community as a generic classification term to refer to and encompass a broad range of chemicals used for controlling various "pests" (e.g., herbicides – weeds; insecticides – insects; fungicides – fungi and bacteria and viruses; nematicides – nematodes; arcaricides – mites; rodenticides - rodents; Schwab et al. 1995). That is, there is no one pesticide per se. However, the study findings indicate that 30 percent of respondents did not perceive herbicides to be a pesticide, nor did they believe that these two categories posed the same dangers. According to the legal definition of pesticides used in South African legislation (see footnote 26), herbicides are considered to be a pesticide and are regulated accordingly.

Toilet cleaners were the most controversial item cited, with the majority of respondents (69.6 percent) naming these as a pesticide. Showing insight on their part, farm workers indicated that toilet cleaners are a pesticide because they kill germs, which were viewed as pests; that is, some farm workers view toilet cleaners as biocides. However toilet cleaners are not presently registered as biocides in South Africa (see footnote 31 above).

Furthermore, 20 percent of respondents did not believe that shampoo for lice control was a pesticide, although the active ingredients in these products are pesticides. Also 32 percent of respondents believed that room fresheners were a pesticide. What is illustrated by these findings is respondents' confusion as to what a pesticide is in terms of how pesticides are legally defined in South Africa (see footnote 29). Again the implications of these perceptions are not fully clear. A possible social framing effect on

this confusion of what a pesticide is is the lack of clarity, that is fragmentation, of South African legislation regulating different aspects of pesticides across 14 different pieces of legislation and 7 different government departments as discussed in Chapter Two (see Table 2). Potentially authority figures are the vehicles for providing this confusion of what a pesticide is amongst farm workers (see discussion of authority influences below). Again this would need to be further researched.

5.3.1.1.b Farm Workers' Conceptualization in Relation to Use and Function

Chapter Two (Table 2) also highlighted that all pesticides not used on the human body are regulated by one Act under the Department of Agriculture, and that those used on the human body (e.g., repellents, lice shampoo) are regulated by another Act under the Department of Health, and furthermore that maximum residue limits in food are regulated yet under another Act and so on. The government has thus defined pesticides by use purposes and in effect, so have farm workers (i.e., a social framing influence); it is just that government's and farm worker's definitions do not necessarily agree.

In attempting to understand how farm workers conceptualize pesticides, farm workers' perception of the purpose[48] of pesticides was solicited. Table 7 illustrated that farm workers do not necessarily interpret pesticides purpose in line with what their legally registered use is. That is, the purpose of pesticides extended beyond pest control to keeping the individual healthy (41.7 percent), for general cleaning (43.5 percent) and

[48] The purpose of a pesticide (i.e., agricultural remedy) as defined by the Department of Agriculture, in the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act 36 of 1947) is for : "...destroying, stupefying, repelling, inhibiting the feeding of, or preventing infestation by or attacks of, any pest in relation to a plant, a place or a thing; destroying a plant; modifying the physiology of a plant or pest so as to alter its natural development, productivity, quality or reproductive capacity; attracting a pest for the purpose of controlling or monitoring it; enhancing the symbiotic nitrogen fixation of plants; or modifying an effect of another agricultural remedy [pesticides] and includes household remedies."

to kill germs (2.6 percent). A good example to conflicting definitions of purpose between the government and farm workers was where one farm worker described the use of pesticides for washing blankets. This is considered an illegal practice in terms of what pesticides are legislated for, but this worker perceived the use for washing blankets to be one intended purpose of pesticides.

5.3.1.1.c Farm Workers' Conceptualization Affects on Safety Behaviors

Farm workers' varying perceptions of what constitutes a pesticide, as was illustrated above, may in turn result in risky safety behaviors. As farm workers generally lacked clarity on what a pesticide actually is (e.g., 32.2 percent indicated room fresheners, 69.6 percent toilet cleaners, 5.2 percent Vaseline) and what a pesticide is used for (e.g., 43.5 percent citing general cleaning purposes), these misperceptions and perception in turn influence their safety behaviors. For example, study respondents' belief that herbicides are not pesticides makes risk communication of hazards and safety behavior difficult because if the respondent thinks the information is meant for pesticides, then the information may not be applied to herbicides.[49] The study findings suggest that the cultural framing of respondents identifies pesticides as being products that have a hygienic element to them (i.e., clean, make fresh, kill germs) and are used for cleaning purposes. For example, the cultural bias that pesticides can be used for general cleaning could potentially lead some respondents to have high risk behavior practices as they would be applying the "pesticide" in conditions for which use of is not legally approved resulting in potentially high exposures. Future ethnographic research on pesticide perceptions should assess individual's cultural biases of insects and whether, in

[49] Although not within the scope of this research project (farm workers in fruit production), the same applies to shampoo for lice control (both for animal enterprises and for personal use).

South Africa, there is a tendency to view pests as "dirty" and thus pesticides as having "cleansing" properties.

What is unclear are the consequences of 70 percent of farm workers perceiving toilet cleaners to be pesticides. On the one hand if the view is that pesticides are hazardous and dangerous, and toilet cleaners are categorized as pesticides, then perhaps toilet cleaners will be handled with greater care. However, on the other hand, if pesticides are seen as not so dangerous, and toilet cleaners are categorized as pesticides, then perhaps toilet cleaners will be handled and stored inaccurately in the home environment where they are readily accessible, near food, etc. Or the reverse is possible. If toilet cleaners are not seen as hazardous or dangerous (e.g., as one respondent indicated that "something you clean with [like *jik* – bleach] is not dangerous"), and toilet cleaners are classified as pesticides, then perhaps pesticides will be viewed as not dangerous and handled so. Toilet cleaners in South Africa are not registered for use under a particular Act but instead are sold under the company's license to sell the product. Thus, toilet cleaners do not have the same warnings, danger signs or color codes on them as pesticides, whereas pesticide labels in South Africa have more warning, precautionary and hazard information on them than toilet cleaners, because of legislated requirements (see Table 2 in Chapter Two). The cultural rationality of perceiving pesticides and toilet cleaners to be one and the same potentially exposes the end user to greater health risks as toilet cleaners are readily accessible and not subjected to the same registration process as pesticides.

Also problematic was that 20 percent of respondents believed that lice shampoo was not a pesticide (see Table 5). The implication of confusing lice shampoo to be as

safe as regular shampoo is that respondents may be exposing themselves or their children to dangerous amounts, frequencies or lengths of application periods because of this misperception.

5.3.1.2. Pesticide Risk Perceptions – Exposure Prevention

All male farm workers interviewed believed they needed to protect themselves from pesticide exposures, along with 94 percent of female respondents. Farm workers' perception of protecting themselves from pesticide exposures through the use of PPE is discussed in several sections below. However, farm workers also held other beliefs on how they could protect themselves which highlights their self efficacy view to exposure prevention, as well as their misconceptions of exposure risks. For example, some women farm workers believed they could protect themselves by turning their backs to the men spraying or working 3-4 rows away from the sprayers or by putting Calamine lotion on their faces. All of these precautionary measures give the illusion of protection while actually enhancing or increasing exposure.

A further example of protection perceptions and misperceptions is the view of drinking milk (see Table 18). This is a common view held in South Africa. During one focus group male workers indicated that they drank milk before spraying as they believed this provided (e.g., "coated") them with protection from pesticides potential harmful effects.

5.3.1.3. Pesticide Risk Perceptions – Soliciting Perceptions

Despite efforts to encourage farm workers to articulate their perceptions (i.e., beliefs, attitudes), it became clear that pesticide risk perception was a difficult and

perhaps a new concept as a considerable number of workers expressed their lack of ability to respond substantively to perception questions by saying "don't know". For example, 21 percent of respondents did not know what factor was influencing their perception of a pesticide being dangerous or not; similarly 18 percent could not say what influenced their perception of a pesticide being poisonous; and furthermore, 28 percent of respondents did not know how they could tell which pesticides made them sick and which did not although they had the perception that all pesticides can make them sick.

The interviewers frequently reported that they felt that the respondents had never conceptualized these issues before and that respondents struggled to reckon what their perceptions were on the issues posed. This would suggest that the *importance value* (see CSPM in Chapter Three) of risks associated with pesticides was generally low. This highlights (1) the historical legacy of farm workers being "told" what to believe; (2) that farm workers' pesticide risk perceptions do not pose a political threat; and (3) that, from the perspective of social and economic elites in South Africa, risk communication tools are not needed in South Africa to "alter" farm workers' perceptions (i.e., the present perceptions are not a "threat" to industry or government agendas). Despite the struggles with formulating their risk perceptions, farm workers did appear willing to grapple with and think about the concepts presented to them. Farm workers responded positively to the research and were keen to obtain more information which could aid in their being able to formulate opinions about pesticide risks in the future. If farm workers were regularly provided with empirically (i.e., technological rational) based information about pesticides they work with from authority figures (i.e., individuals respected but who do

not have a vested interested in the farming operation), then the apartheid legacy and the burden of the pesticide culture could begin to be analyzed and contested.

5.3.1.4. Pesticide Risk Perceptions – Linguistic Interpretations

There appears to be ambiguity between distinguishing whether a pesticide was poisonous and/or dangerous (see Table 8) and how to assess poisonous (see Table 9) and dangerous (see Table 10). This ambiguity seems to arise from the interplay of the words in Afrikaans to mean the same thing colloquially (see 5.3.1. above and Focus Group discussion in Chapter Four) rather than the intended meanings as is given by the Oxford dictionary (see Section 5.2.1.3.b. above).

Some farm worker's socially and culturally framed perceptions employed in classifying which pesticides are and are not poisonous were inaccurate (e.g., smell is not an indicator of how poisonous a substance is; see Table 9). For example, various farm workers interviewed appear to make assessments of poisonousness based on the physical attributes (e.g., the smell, potency of the mixed solution) of the pesticides rather than the chemical compound itself (i.e., whether it was an organophosphate or a pyrethroid) or based on the label. Thus the risk judgment in this case was derived from their cultural framing effect influenced by what can be "seen" (i.e., is tangible) as the "unseen" (i.e., intangible) cannot factor in the risk equation.

The perception of differences between acute and chronic health effects indicates that farm workers were not only formulating risk perceptions about pesticides, but that they were also formulating degrees of effects for both the present and future context. This highlights 90 percent of participating farm workers' potential to make an association between health effects they have later in life and the fact that they may have

previously been exposed to pesticides. This may imply that farm workers have the potential to associate current exposure with future negative impacts (i.e., that pesticide exposures are not necessarily benign just because one did not become sick immediately after the exposure). Based on this finding, educational interventions could be introduced to protect farm workers from negative exposures. Future research should identify farm workers perceived acute and chronic health effects, what pesticides farm workers think cause acute and chronic health effects, and why acute effects are not seen as severe as chronic effects (see Section 5.2.1.4.b above), in order to comprehend how these perceptions influence appropriate safety behavior and to identify target areas for educational interventions.

5.3.1.5. Social/Cultural Influences on Perceptions of Health Effects

The results of this study indicate that farm worker respondents had some understanding of the technological rational health implications of pesticide exposures (see Table 13). However, there were some health effects mentioned that are neither caused by pesticides (e.g., tuberculosis) nor a common effect of pesticide exposure (e.g., blindness). The belief that pesticides cause these health effects was framed by the social/cultural context within which farm workers work and live. According to London et al. (1998), health indicators suggest that South African farm workers have a high burden of disease. For example, a high percentage of farm workers in the Western Cape suffer from tuberculosis (1,000/100,000) and various eye ailments (e.g., cataracts, skin growth over eye[50]). This perception is important in terms of misconceptions about pesticides as pesticides can cause lung damage, but not TB. Thus the questions arising

[50] Data on rates of eye ailments is not available for the general population, let alone farm workers.

are: do respondents view pesticides risks as severe enough that exposure could cause TB? Or is pesticide exposure a culturally rational scapegoat for the contraction of AIDS? That is, instead of acknowledging TB's link to AIDS or that AIDS is a sexually transmitted disease because of the social stigma attached to AIDS, it is easier to blame pesticides. Or is the fact that many farm workers have TB a confounding factor because people do not understand how TB is contracted and many are exposed to pesticides? These issues should be further researched in order to address these misconstructed perceptions.

A recent study in the Western Cape (Maruping et al. 2003) revealed that farm workers make significant use of pesticides to commit suicide. The study showed that farm workers in the Western Cape are five times more likely to use pesticides in suicide attempts than non-farm workers and that farm residents are eight times more likely to commit suicide than non-farm residents. This could be a social framing factor as to why such a high percentage of farm workers, that is 74 percent, believed pesticides can cause death.

5.3.2. Discussion of Background Influences on Risk Perception

5.3.2.1. "Authority" Influences

Highlighted in the findings in this chapter and throughout the dissertation is the social framing effect authority figures have on farm workers' pesticide risk perceptions. That is, the pesticide industry, the farm owner and/or manager and the government (e.g., Environmental Health Officers, agricultural extension officers) all influence farm

workers' risk perceptions (i.e., cognitive products and worldviews).[51] Although general workers, spraymen and tractor drivers generally had a higher risk perception than foremen and supervisors, the ethnographic findings in this study showed that the former deferred to the latter for decision-making about how poisonous or dangerous pesticides are and whether the pesticide will make one sick or not (see Tables 9, 10 and 12). What this implies is that although general workers, spraymen and tractor drivers had high risk perceptions when questioned individually about pesticide risks, when it comes to decision making about pesticide risks, foreman and supervisors, with lower risk perceptions, were influential over the other workers. Namely, a farm worker's pesticide risk perception and safety behavior decision making appear to be contingent on the social position (employee) and influenced by the "boss" who controls that social position. That is, influenced by the "boss's" own risk perceptions, and in this study foreman and farm supervisors had a very low pesticide risk perception.

The pesticide label itself was the most frequent "authority figure" stated by study respondents as informing farm workers' decisions on pesticide risks (see ethnographic findings in Tables 9, 10 and 12). The implication of farm workers' trust in this technological rational interpretation of risk is further discussed in Chapter Six.

In terms of cultural theory of risk perception (see Chapter Three), the employee's perception is influenced by the culture of the group, namely the work environment influenced by the pesticide culture discussed in Chapter Two and the deference to authority (in the CSPM this refers to the individual's personal context and circumstances). This situation is a legacy from the Apartheid era which still exists today

[51] As authority influences was an outcome (i.e., finding) of this research on farm workers' perceptions, the full spectrum of these influences was not investigated, but should be in future research (e.g., the role of the church, the role of community leaders).

(i.e., cultural theory's cultural rules/grid within a society). This is especially evident in that many farm workers believe in the "safe use" concept (i.e., the technological rationality of the pesticide industry body GIFAP) that pesticides are "safe" as long PPE's are used, and that no "unsafe" pesticides are registered in South Africa. For example, 80 percent of workers indicated they would not work with pesticides unless they have PPE (i.e., safe use message that as long as PPE are worn pesticides are safe). However, only 34 percent of respondents cited using PPE when asked how they could protect themselves, 17 percent said they would continue working without PPE and extended observation of farm workers working in the field revealed that the majority of farm workers work without PPE when working with pesticides. Thus the findings show that the "belief" in the safe use concept of using PPE exists amongst farm workers, but the "practice" of using PPE is lacking.

The socially and culturally constructed meanings respondents provided in terms of how they knew which pesticides would make them sick (see Table 12) also highlighted the reliance of 22 percent of respondents on "authority" figures (e.g., foreman, farm owner, the person's mother) to tell them which pesticides will make them sick and which will not. Thus the responses above highlight the role of authority figures (e.g., the farm foreman and owner) in the social framing effect of some farm workers' pesticide risk perception and the influence these have on farm workers' health and safety decision-making processes.

Another example of authority influences on farm workers' risk perceptions is the influence of the pesticide industry's campaign to portray pesticides as safe through the industry's safe use program (see Chapter Two for an in depth discussion). That is, the

framing effect of the technological rationality of the pesticide industry (i.e., the expert) on the cultural rationality of the farm worker (i.e., the lay). Although farm workers generally had high perceptions that all pesticides were dangerous, the risks were perceived to be removed when protective clothing was worn (see above for discussion of other protection approaches). This perspective that pesticide risks are controllable by PPE stems from the pesticide industry's technological rationality, that is, "safe use" campaigns (see Chapter Two). However, other than the obvious spraying of pesticides, there are numerous exposure scenarios where farm workers are not provided with PPE (e.g., harvesting or weeding recently sprayed crops as reentry intervals are not adhered to, cleaning contaminated equipment or clothing, unloading pesticide containers, burning pesticide containers[52]). One heath and safety training manager on a prestigious wine farm in the Western Cape explained how herbicides were generally safe and once water was added to the active ingredient you could drink the solution and nothing would happen to you.[53] He went on to explain how a mixed solution was "safe" and therefore those spraying did not need protective equipment; only the mixers and handlers of the pesticide needed PPE in his view. Thus his self-efficacy was one where he viewed his ability to control his and his workers' exposure to risks by mixing the pesticide with water.

Generally, the cultural dimensions of the relationship between farm worker and farmer emphasize the latter giving instructions and the former acting on the instructions

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[52] Burning of pesticide containers is a common practice in the Western Cape to prevent the re-use of containers. This practice is recommended by farmers and industry despite the fact that some labels state that some pesticide containers should not be burnt.

[53] This perception is influenced by pesticide sales agents who are believed to have previously advertised the "safeness" of herbicides by drinking or eating the pesticide in front of farmers. Prof. London of the University of Cape Town personally witnessed a farmer in 2002 take a drink from a herbicide container to prove that it was safe (personal communication with Leslie London, 2003).

(cf. Newby 1977). There is no role for questioning or discussing. This further supports the authoritative view that farmers are the experts on pesticides and that farm workers as the lay must only receive knowledge and accept it rather than question it. When farm workers are provided with information about pesticides, this information is taken at face value, trusted and not questioned. Farm workers' risk perceptions and world views are thus not devoid of the influence of the social/cultural context within which they work and live. As stated under the Cultural Theory section in Chapter Three, risk perceptions are not homogeneous but vary according to cultural and contextual biases. These biases influencing farm workers' risk perceptions are a result of the way in which the information about pesticide risks has been framed for farm workers by authority influences.

The qualitative findings highlight the role the farm foreman and farm owner play in the formation of farm workers' pesticide risk perceptions and their influence on farm workers' health and safety decision-making (see Tables 9, 10, 12,14 and 16). To what extent the foreman and owner are transmitting the information on the label versus telling the workers what management wants the workers to believe is an important issue. The sense, based on observations and the study findings, is that predominately farm owner's perceptions (i.e., cultural rationality) and economic interests are the dominating influence over farm workers' perceptions and that the farm owner's perceptions are not always matched with the information on the label (e.g., instructing that pesticide containers be burnt which the label expressly states not to; further discussed in Chapter Six).

The cultural construction of pesticide risks is expressed in the tendency of those who are in authority to put the blame of poisoning on the end user. This is articulated by authority figures through stating that pesticide users who are poisoned are "irresponsible" or "negligent", rather than admitting that pesticides are toxic to highly toxic, that exposure must be avoided, and that socio-economic contexts (especially of farm workers) in South Africa lend themselves to poisoning incidents. The statements of "irresponsible" or "negligent" illustrate how industry and government put the liability and blame of poisoning on the end user (i.e., view pesticide risks objectively). For example, on the government forms for notifying a pesticide poisoning[54], one technological rational category for "why" the person was poisoned is "negligence." The assumption is that the end user's self-efficacy in controlling the risk associated with pesticide use is irrespective of context, and personal, social and economic circumstances.

5.3.2.2. Influence of Gender

Pesticide risk perceptions are also influenced by whether the perceiver is a male or female. However, the results of this study indicate that it is not sex per se that directly causes variation in perception, but rather that because the person is female, her social and cultural context varies from that of most males, which in turn frames her perceptions of pesticide risks. Not only does the context vary, but the assumptions about the female role within this context affect male and female perceptions of what risks women encounter with regard to pesticides.

In this study, women viewed pesticides as dangerous seven percent less than men and poisonous 11 percent less than men (see Table 17). The study findings indicate that

[54] Pesticide poisoning is a medical notifiable condition under the Health Act (see Table 2 in Chapter Two).

the social framing of women's work roles influences this gender variation in the perception of dangerous and poisonous. As described in Chapter Two, women's social context is that they are repeatedly exposed to pesticides while working, but are not provided with any form of protection as their exposure is dismissed or trivialized to imply that there is no objective risk.

The results of this study also show that there is a gender variation in relation to cautionary behavior; pesticide protection measures differ between male and female farm workers (see Table 18). Females in the study focused on avoiding exposure to pesticides in relation to physical proximity to pesticide spraying activities (e.g., "I walk a wide or long distance from the people that are spraying."). On the other hand, males in the study believed that they could protect themselves regardless of the degree of exposure, even if that protection is defined as going to the doctor. Interestingly, women's self efficacy protection measures were based on removing themselves physically from pesticide exposures; however none of the women spoke of reentry interval restrictions even those these are in line with their preventative orientation.

Women working in fields do not regularly have access to personal protection equipment (PPE), as working in the fields is not seen (by farm owners, operators, managers, and foremen, and the women themselves) as a source of exposure requiring PPE (i.e., technological rationality conflicting with social reality). Only directly spraying pesticides is seen as a source of exposure; since this is predominately a male task, predominately only men are provided with PPE. As explained in Chapter Two, women's exposure to pesticides is underestimated. That is, women's work is perceived

by themselves and others as not "dangerous". Thus there is a gendered variation and cultural bias in the provision of PPE.

Predominately, spraying pesticides is considered a man's job and men are given the official title of "sprayman". However, when the spraying season is in full swing, some farms do not have enough "spraymen" to do the work and women are requested to conduct spraying as well. However, these "spraywomen" receive little if any pesticide training as they are not perceived to spray pesticides regularly and casual spraying is not classified at the same exposure risk as regular spraying.

5.3.2.3. Right of Access to Risk Information

According to South African labor legislation, it is all farm workers (including women) right to have access to training and education. However, as previously illustrated from the study findings (see Table 36), most women do not have the right of access to or receipt of pesticide training and hazard/safety information, because of the gendered perception of their work and pesticide exposures. Interestingly, the gendered perception of women's non-exposure to pesticides and their paucity in training experience appear to influence their subjective perceptions of risks associated with pesticides. For example, males in this study were more likely to say that pesticides negatively affect fertility, the fetus of an exposed pregnant woman and the health of farm workers' children than females (see Table 17).

Although there is not a uniform distinction across the interviewed farms of who is trained or receives information about pesticides, there exists a hierarchy within the various farms. As a general rule for most of the farms, women do not receive training as they are perceived as not spraying or applying pesticides (only 8.7 percent of female

study respondents have indicated they had received information or training on pesticides; see Table 37). This was the case despite the fact that four percent of women said they mixed pesticides, 13 percent of women said they sprayed, and 17 percent of women said they either cleaned spray equipment/clothing or handled pesticides. For example, on one farm the women mixed the pesticides and poured the mixture into the backpack sprayer for the men. This task was not viewed by the manager as having contact with the pesticide requiring training despite mixing and pouring being high exposure work. Therefore the men who sprayed were trained but not the women who mixed the pesticides. The social framing effect of the view of women farm workers as not doing technical, hazardous tasks contributes to a gender variation in training because it supports the belief, by both workers and authority figures, than women are not exposed to pesticide risks .

Access to information influences risk perceptions, as do the types of information the individual is exposed to. Occupation influences perception as well in that when farm workers work with pesticides they are exposed to more information both formally (e.g., training) and informally (e.g., discussion amongst co-workers) than other farm workers. In this study only 29 percent of general farm workers received pesticide training, in contrast to 54 percent of spraymen and 69 percent of spray tractor drivers (see Table 33). An interesting significant finding is that spraymen were less likely to receive training in comparison to other work categories (driver, foremen), except for general workers (see Table 34).

In relation to those farm workers who worked with pesticides, the study findings showed that only 27 percent received training and 24 percent did not (see Table 35).

This further highlights the inconsistency in who receives training. The risk perception literature makes little reference to the role access to information and misinformation has on shaping individual's worldviews and resulting risk perceptions.

5.3.2.4. A Little Bit of Knowledge May Be Risky

In this study, farm workers with a lower educational level were more likely to believe that all pesticides are poisonous and that pesticides could affect the fertility of farm workers (see Table 19). Overall in this study, farm workers with a lower educational level had higher pesticide risk perceptions than high level of education farm workers. One could hypothesize that the formal education system is more likely to present technological innovations, such as pesticides, in a more favorable and positive light as alleviating poverty and promoting sustainable development. Thus farm workers exposed to formal education for a longer period may view pesticides favorably and not so dangerous. Whereas, farm workers not exposed to the formal education system as much or at all perhaps approach technological innovations less on the basis of indoctrination and more on the basis of experience and common sense. Thus those farm workers with less education perhaps view pesticides as more risky through believing all pesticides are poisonous. From the study findings on education, one could conclude that formal education appears to lead to the adoption of technological rationality.

5.3.2.5. Previous Experience Influence on Perception

A hypothesis in this study was that exposure to a previous experience (e.g., being made sick by pesticides) was an influence on risk perception ultimately influencing safety behavior. The risk perception literature claims that personal context and

circumstances, such as being made sick by a pesticide, has a strong influence on perception (Langford et al. 2000a; Krimsky and Golding 1992). That is, the availability heuristic (i.e., the ease with which an incidence of being made sick is brought to mind; see Chapter Three) is regarded as important for understanding perceived risk. In this study, 25 percent of respondents claimed they had previously been made sick from pesticides. The study findings showed that those respondents who identified with being previously made sick from pesticides generally had a marked higher risk perception for six beliefs when this variable was added to the perception equation (see Table 38). Thus the study findings appear to be consistent with the literature assumptions on personal context and circumstances.

5.3.2.6. Perception of the Moment

As has been repeatedly stated throughout this dissertation, conducting pesticide risk perception research with farm workers in South Africa proved to be difficult and somewhat problematic. Since pesticide risk perceptions are not stimulated through environmental activism, and are not incorporated into, and do not influence, policy (as is the case in the United States), there is no culture of polling, or process to solicit, pesticide risk perceptions. Consequently, farm workers' perceptions seemed to be heavily influenced by the "factor of the moment" (e.g., the farmer, the foreman, the questionnaire, the pesticide label, pictograms, the interviewers, the environmental health officer, co-workers) as was evident by some inconsistencies in answers for similar questions. Risk perceptions are not stagnant (see Risk Perception literature in Chapter Three), however when conducting research on risk perceptions how does one assess a perception that changes in the course of an interview? In terms of this research, what

became evident was what the researcher terms "the perception of the moment". Perhaps this is equivalent to Langford et al. (2000a) first stage (development) of attitude influencing perceptions. However, farm workers' perceptions changed to suit the influence of the moment and the reason for this is that they did not have a firm conviction on the issue themselves nor the social-economic viability to go against the technological rationality of the authority influences, and were thus easily swayed by whomever or whatever was offering them information. This reemphasizes the point of the framing effect of information and access to information on risk perceptions.

Perhaps these "perceptions of the moment" are also illustrative of Plough and Krimsky's (1987) competing rationalities (technical and cultural) for the interpretation of risk (see Chapter One) and highlights the social construction of risk. As previously stated, farm workers' pesticide risk perceptions are not stagnant and fluctuate depending on the context (e.g., social, economic, political) and contextual influence on the farm worker (e.g., manager, farm owner, co-worker). The technical rationality farm workers are exposed to oscillates between pesticides are safe (i.e., industry safe use campaigns) and pesticides are dangerous (e.g., provision of PPE, skull and cross bones on labels). The cultural rationality influence on farm workers' risk perceptions oscillate between experience (e.g., having worked with pesticides and become sick) and socio-economic status (e.g., the threat of losing one's job). Thus farm workers present the risk perception of the moment (i.e., a socially constructed view of risk) which coincides with the risk rationality that they assume is held by the "factor of the moment" (see above in this section).

5.4. CONCLUSION

This chapter's findings and discussions have presented and conferred the various social and cultural framing effects on farm workers' pesticide risk perceptions. In summary, the cultural framing effects highlighted which influence farm workers' perceptions are:

1. the cultural belief that pesticides have a hygienic element to them and can therefore be used for cleaning purposes;
2. the cultural belief that pesticides and toilet cleaners are the same;
3. the existence of a pesticide culture;
4. deferring to authority unquestionably;
5. view that tuberculosis and blindness, common health conditions for farm workers, are caused by pesticides;
6. the cultural framing of what is tangible and non-tangible about pesticides in making pesticide risk judgments; and
7. the cultural construction of pesticide risks being caused by the end-user.

The social framing effects highlighted that influence farm workers' perceptions are:

1. the present fragmentation of South Africa's pesticide legislation on farm workers' confusion of what a pesticide is;
2. farm workers definition of pesticides based on their use purposes;
3. the use of pesticides by farm workers to commit suicide influencing the high belief that pesticides cause death;
4. authority figure influences on perception, precautions and decision-making; and
5. the social framing of women's work influence on the gender variation in perception of pesticides being poisonous and dangerous.

Chapter Two discussed how pesticide use in South Africa is not a political issue and that there is a culture in South Africa which positively supports the use of pesticides. Cultural theory presented in Chapter Three describes how people react to risks in accordance with the way in which society is perceived, as well as the legitimacy that

they ascribe to institutions and rules of procedure. Farm workers in the Western Cape generally perceive pesticides as risky, but are confused what a pesticide is. Without a broad understanding of the varying levels of risk associated with pesticides and that pesticide users as individuals have different contextual risks in relation to each other, farm workers tend to take risks at the mercy of fate. That is, their cultural rationality has minimized the technological rational risks as a result of their social, economic, political and cultural context. Foremen, farm owners, pesticide representatives and others who influence farm workers' perception, tend to have a "cyclopic" view of risk; that is, only one side of reality is perceived (Renn and Klinke 2004). Thus those influencing perceptions are the transmitters of the technological rationality presented by the pesticide industry and supported through the pesticide label. Consequently farm workers' repeated and hazardous exposures to pesticides have become socially acceptable risks and farm workers' high perceptions of risk do not presently influence a reduction in these hazardous exposures.

This chapter presented the various components of the research findings that illustrate how farm workers in the Western Cape have varying perceptions of pesticides and pesticide risks, as well as varying background influences and framing effects on their pesticide risk perceptions affected by gender, job position, training, access to information, and authority influences (e.g., the foreman, "boss", farm owner). Although farm workers had relatively high perceptions of risks associated with pesticides, their perceptions were sometimes confused, misleading and lacking in the ability to promote a safety behavior capable of protecting their health. Farm workers had limited pre-existing cognitive products (i.e., self-efficacy, behavioral expectations and importance

values; see CSPM in Chapter Three) in relation to pesticide risks which influenced their perceptions and were influenced by various background influences on pesticide risk perceptions highlighted above. Farm workers' socially constructed risk perceptions were shaped by their own social and cultural circumstances, authority influences and were unstable, as well as fluctuating to reflect their "perceptions of the moment."

As farm workers' risk perceptions were highly framed by social and cultural factors, this leads me to return to the original hypothesis of this dissertation that an interaction exists between risk perception and risk communication which in turns influences farm workers pesticide use safety behaviors. Authority figures communicating risks were cited as a significant influence on farm workers' perceptions, while the pesticide label was cited as the most significant influence on perceptions of pesticides being poisonous, dangerous and/or making workers sick. To further the interaction discussion, Chapter Six aptly looks at the role of the pesticide label as a risk communication vehicle in influencing or being influenced by farm workers risk perceptions.

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RISK PERCEPTION, RISK COMMUNICATION, AND THE EFFECTIVENESS OF PESTICIDE LABELS IN COMMUNICATING HAZARDS TO SOUTH AFRICAN FARM WORKERS

Volume II

By

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CHAPTER SIX

THE ROLE OF PESTICIDE LABELS IN THE SOCIAL AMPLIFICATION/ATTENUATION OF RISK

6.1. INTRODUCTION

Congruent with the literature review in Chapter Three on risk communication, this chapter presents and discusses the study findings concerning the elements of the pesticide label, how farm workers interpret these elements, and what social and cultural factors influence a farm worker's interpretation of the label. Also provided in this chapter is an analysis of the pesticide label's general role as a risk communication medium and whether this communication amplifies or muffles the message for South African farm workers. As described in Chapter Three, the social amplification model views the social structure of risk communication as consisting of sources (e.g., scientists, pesticide industry), transmitters (e.g., media, pesticide labels), and receivers (e.g., general public, farm workers; Renn 1991). "Amplification" is used in this chapter in line with how Kasperson et al. (1998) used it to include how the pesticide label both intensifies signals of risk, as well as attenuates signals about risk. This chapter is divided into sections presenting this study's quantitative and ethnographic findings along with a discussion of the components of the pesticide label (Section 6.2), occupational influence on label comprehension (Section 6.3) and gender influence on label comprehension (Section 6.4), and finally the conclusion (Section 6.5).

6.1.1. Pesticide Labels as Transmitters – Do You Hear What I Hear?

Before analyzing the respondents' interpretations of the various components of the pesticide label, there is a need to unpack the concept of "comprehension". In order

for the pesticide label to be effective as a risk communication tool, comprehension is the key first step before precautionary behavior can be provoked. However, comprehension is not a straightforward technical or "objective" process as the literature review on risk perception and risk communication highlighted (see Chapter Three). In order for farm workers to use the pesticide label for making risk decisions leading to risk precautionary behaviors, the worker must "receive" information being transmitted by the pesticide label and begin the process of "comprehension". The transmission process with the pesticide label is that the information will be "received" through the reading of the label (for the literate), and the viewing and interpreting of the pictograms and color codes (for semi-literate and illiterate persons). Thus with "comprehension" being a key element of the effective understanding of the components of the pesticide label, this research paid particular attention to (1) whether respondents noticed or knew about or looked for the information on pesticide labels, (2) their literacy capacity, and (3) the various factors and social dimensions influencing respondents' interpretations.

6.1.2. Comprehending the Pesticide Label

As a legal document, pesticide labels used in South Africa are designed to present product information, use specifications, hazard and precautionary information, and first aid and medical treatment information. This research focused on analyzing what meanings farm workers obtain from pesticide labels in order to assess whether an "appropriate" safety behavior could be executed based on their conceptualized meaning.

According to Easterby and Hakiel (1977), the information, pictograms and color codes found on pesticide labels tend to fall into one of the following technological rational categories:

- Descriptive – where the information/symbol identifies the hazards
- Prescriptive – where the information/symbol prescribes some positive course of action to be taken
- Proscriptive – where a course of action is prohibited.

However, distinctive clarity between these three categories is not always evident. In this study it was revealed that farm workers at times inter-mix the meanings from these three different categories or lack understanding of the information and symbols altogether. What are meant to be three clearly distinctive categories for presenting information were not always interpreted in isolation of each other, as shown below, and were often confused.

6.2. FINDINGS AND DISCUSSION: LABEL COMPREHENSION

The risk communication findings on label comprehension and the discussions thereof are presented in the following subsections: the label (Section 6.2.1), the alerting function of the label components (Section 6.2.2), the effectiveness of pictograms (Section 6.2.3), the effectiveness of color for toxicity (Section 6.2.4), comprehension of precautionary instructions (Section 6.2.5) and farm workers' trust in the pesticide label information (Section 6.2.6).

6.2.1. The Label

The first step in assessing the effectiveness of pesticide labels as risk communication tools is to find out whether or not labels are noticed and, if noticed, whether labels are identified as an information resource. Four actual pesticide labels (see Appendixes B-E), from commonly used pesticides in the Western Cape, were used for assessing if farm workers could identify what the pesticide label is and what it is used for.

When shown one of the four study labels and asked "Do you know what this is?"; 48 percent knew what the pesticide label was, while 52 percent did not. Thus, more than half of the respondents could not identify what a label is. The 48 percent of respondents who said they knew what the label was, were then asked to identify it (i.e., give it a name, such as, a piece of paper, information, a label); slightly more than three-quarters of these respondents (35.6 percent of the total sample) were able to correctly identify the "label or *etiket*". Those respondents who were unable to name labels were then informed by the interviewers that these were called labels or *etikets* and found on pesticide containers for consistency in answering the questions that followed.

6.2.2. The Alerting Function of the Label Components

Less than half of the respondents (39.1 percent) indicated that they had "used" a pesticide label either at work or at home in the past year.[55] These respondents were then asked to unpack "used" by answering the question, "What did you use the information for?" Table 40 lists the responses to this question.

The responses in Table 40 indicate that although the pesticide label is used for a broad range of purposes, use of the label in general is low. Also from the responses in Table 40 it is evident that the most common use of the label is for instructions and measurements (55.6 percent), warnings and precautions (55.6 percent) and what PPE to

[55] The implication here is that three percent of the respondents who indicated they used a pesticide label in the past year were unable to correctly name a label. That is, they used the label, but did not know what it was called. Another possibility is that some respondents may have used a pesticide label from pesticides used at home, which are different from the labels used on agricultural pesticides used at work and therefore did not recognize one of the agricultural labels in Appendices B-E. This, however, is not necessarily an indication of a research problem, as there is not a correlation between naming a label and using a label.

TABLE 40: What Respondents Used the Pesticide Label For In the Past Year (N=45)

Pesticide Label Uses	(%)
What PPE to use	55.6
Instructions & measurements	55.6
Warnings & precautions	55.6
First aid information	6.7
For safety	4.4
For how harmful pesticide is	4.4
For when to harvest a crop	2.2
For types of sicknesses you can get	2.2
To help understand label	2.2
For health purposes	2.2
To know that you must wash	2.2
To refresh one's memory	2.2
To tell you not to use near people working in the vineyard	2.2
For the ingredients	2.2
To know the type of pesticide	2.2
So as to use pesticide in the right way	2.2
Don't know	2.2

Percentages add to more than 100 as respondents were able to report more than one use.

use (55.6 percent).[56] Of interest is the large gap between respondents' use of the first three items listed in Table 40 and the fourth item, first aid information. As this was an unprompted question, this leads me to surmise that (1) respondents generally do not use the label for first aid information and (2) respondents may not be aware of first aid information existing on the label (assuming they can read the language of the label). This point highlights the question of how farm workers first learn about pesticide labels, as well as learn about what is on the label. Could this large difference seen in Table 40 be a

[56] It is unclear why these three responses all had the same percentage (i.e., 55.6 percent). However, respondents who were familiar with labels and who identified one of the three are more likely to know that all three exist on the able and use all three. Previous training was looked at as a potential reason for these findings being the same. However, for instructions and measurements 52 percent of the 56 percent had received training; for warnings and precautions 46 percent were trained; and for PPE 59 percent had received training. Thus previous training was not a factor producing the same percentage responses. The question was unprompted, however, there were a list of potential responses for interviewers to tick (i.e., code) based on the information sections on pesticide labels (see question E--3.1 in Appendix A); while responses not previously listed in the questionnaire I coded.

result of authority influences focusing only on using labels for PPE, measurements, and warnings and precautions? This finding should be further investigated in future research.

When asked whether there was anything on the pesticide label in Appendix B (*Azinphos-Methyl 350 WP*) that indicated to respondents that that particular pesticide was dangerous, 90 percent of farm workers replied positively; 10 percent did not know if there was something or not. Table 41 illustrates what components of the label influenced the 90 percent of the respondents in stating that *Azinphos-Methyl* was dangerous. The skull and cross bones symbol (see number 4 in Table 42) was by far the most influencing and frequently identified component of the label with respect to farm workers' perception that the pesticide was dangerous (57.7 percent); followed by the color red[57] as the second most frequently identified label component (24.0 percent). The "wear a respirator" pictogram (18.3 percent; see number 9 in Table 42), the "wear gloves" pictogram (16.3 percent; see number 1 in Table 42) and the signal word "very toxic" (12.5 percent) were also identified as significant components of the label highlighting this pesticide's hazardousness.

Results from Table 41 highlight some interesting aspects as to what on the label influenced the respondent's interpretation that the pesticide was dangerous besides color and pictograms. For example, some respondents (3.8 percent) mentioned that the pesticide was dangerous because it is a wettable powder. Others explained, "the powder is dangerous in the stomach" and "stomach pesticide – don't eat fruit before you rinse it" (1.9 percent) based on the first written text found on the label, just below the product name, which reads: "*A wettable powder contact and stomach insecticide for the*

[57] Red labelled pesticides are only registered for agricultural uses as these are considered too hazardous for domestic use.

TABLE 41: Factors on Label Influencing Perception of Dangerous (N=104)

Pesticide Label Uses	(%)
Skull & cross bones pictogram	57.7
Color red color code	24.0
Wear Respirator pictogram	18.3
Wear gloves pictogram	16.3
Signal word: "very toxic"	12.5
Lock away & out of reach	9.6
Livestock & poultry pictogram	8.7
Wear boots pictogram	7.7
All pictograms on the label	7.7
All PPE pictograms on the label	6.7
Wear eye protection pictogram	6.7
Fish and water bodies pictogram	5.8
Wildlife and birds pictogram	3.8
Wettable powder statement	3.8
Stomach pesticides statement	1.9
Wash hands pictogram	1.9
Used for potatoes statement	1.0
Kills insects statement	1.0
Handling granules pictogram	1.0
Diagonal line on some pictograms	1.0
Warnings on the label	1.0

Categories are not mutually exclusive.

control of certain species of insects and mites (as listed) on citrus, deciduous fruit, cotton, potatoes and olives" (see Appendix B). Thus farm workers interpreted aspects of the written text on the label, not intended for communicating human health hazard information, to assess pesticide danger (e.g., kills insects, stomach pesticide). This highlights that pesticide labels serve multiple purposes of which risk communication is only one aspect and that information intended for crop production is used by farm workers as risk communication information.

6.2.3. Effectiveness of Pictograms

In further assessing the effectiveness of the pesticide label, this research investigated what farm workers' interpretations of pictograms are (i.e., their cultural rationality) and explored what effect these interpretations may have on comprehension and ultimately safety behaviors. Ten common pictograms (see Table 42) were selected for analysis from the four pesticide labels used in this study (see Appendices B-E). Respondents were shown the pictograms one at a time and asked if they had seen that particular pictogram before (awareness) and what it meant to them (interpretation). Respondents' answers were first listed in a code book (see Chapter Four) and then, with two exceptions (discussed in section 6.2.3.9 and footnote 51), recoded to fit into five evaluative categories: correct, partially correct, incorrect, critically confused, and don't know. Critically confused refers to an interpretation of information on the pesticide label which would indicate an action leading to a negative or adverse impact putting the farm worker at greater risk than if no risk communication had been attempted.

6.2.3.a Introduction

In line with the mental models approach outlined in Chapter Three, there was an attempt to develop an understanding of workers' mental models for pictograms, and then to categorize each of these mental models in terms of its degree of conformity to the intended definition. In order to appreciate the richness of the workers' mental models, the range of the "correct" category of farm workers' answers (the lay cultural rationality) was restricted to be very close to the pictogram definitions provided by the FAO/GIFAP (the expert technical rationality). The reason for this is that the assumption behind pictograms is that they are simple and straightforward, and thus easily interpreted as

intended by the experts' technical rationality. When coding the results, this research did not allow for too broad of a "correct" definition (i.e., permit an analytical broadening of the definition) as then one would not have captured the full effect of the limitations of the pictograms. For example, many respondents interpreted the "wear boots" pictogram (number 3 in Table 42) to mean "wear boots and overalls". Although this interpretation in theory is not problematic and does not pose a safety hazard, there is another pictogram (seldom used) that illustrates "wear protective overalls". Thus this pictogram (i.e., "wear boots") was specifically intended by FAO/GIFAP to communicate "wear boots" only and nothing else and therefore the answer of "wear boots and overalls" would be categorized as partially correct.

In order to assess if respondents were aware of the existence of pictograms on pesticide labels, they were asked, one by one, whether they had previously seen the 10 study pictograms (question E-9 in Appendix A). All of the 10 pictograms had been previously seen by 55 percent or more of study respondents.

The skull and cross bones symbol was identified by respondents as the most commonly seen (95.7 percent). This outcome corresponds with the results of Table 40 where this pictogram was the most recognized symbol of danger. Of the 10 study pictograms, the expiry date pictogram was the least previously noticed pictogram (54.8 percent). The range of correctly understanding the pictograms as intended by the technological rationality was from 75 percent correct (wear gloves pictogram) to nine percent correct (harmful pictogram). The second to last previously seen pictogram, the St. Andrew's cross (59.1 percent; number 10 in Table 42), was also the least understood pictogram (see section 6.2.3.10.). The most understood pictogram, the wear gloves

pictogram, was the second most previously seen pictogram. Generally the number of correct responses was consistent with the number who had previously seen the particular pictogram prior to this study; for this reason, findings on correctness are presented separately for those who had seen the pictogram before and for those who had not.

Table 42 presents the results for all 10 pictograms. The captions listed in Table 42 under each pictogram are the correct technological definitions for that pictogram. Pictograms presented on the pesticide label do not have this text underneath them. That is, in general pictograms have no captions, although two (skull and cross bones, and the St. Andrew's Cross) are accompanied by signal words. The St. Andrew's Cross pictogram signal word is the same as the definition for this pictogram; however, this is not the case with the skull and cross bones pictogram (see discussion below). The signal words are not listed in Table 42.

The following sections (6.2.3.1. to 6.2.3.10) discuss the quantitative findings shown in Table 42, as well as provide the ethnographic and qualitative findings concerning farm workers' interpretations of what the pictograms are depicting. These quantitative and ethnographic findings below are presented in the same order as the pictograms are listed in Table 42.

TABLE 42: Farm Worker Comprehension of Pesticide Label Pictograms (N=115)

(%)

	FAO/GIFAP vs farm worker definition		Seen Before	Never Seen
1.  wear gloves	74.8	**Correct**	76.1	50.0
	19.1	**Partially correct**	20.2	0
	3.5	**Incorrect**	1.8	33.3
	1.7	**Critical confusion**	1.8	0
	0.9	**Don't know**	0	16.7
	100	**Total**	94.8	5.2
2.  wash after use	48.7	**Correct**	49.5	40.0
	40.9	**Partially correct**	41.9	30.0
	4.3	**Incorrect**	4.8	0
	2.6	**Critical confusion**	1.9	10.0
	3.5	**Don't know**	1.9	20.0
	100	**Total**	91.3	8.7
3.  wear boots	33.9	**Correct**	36.1	22.2
	9.6	**Partially correct**	10.3	5.6
	22.6	**Incorrect**	18.6	44.4
	7.8	**Critical confusion**	8.2	5.6
	4.3	**Don't know**	2.1	16.7
	21.7	**Overall & boots**[1]	24.7	5.6
	100	**Total**	84.3	15.7
4.  hazardous & extremely hazardous (class Ia & Ib)	30.4	**Correct**	31.8	0
	59.1	**Partially correct**	58.2	80.0
	7.8	**Incorrect**	8.2	0
	0	**Critical confusion**	0	0
	2.6	**Don't know**	1.8	20.0
	100	**Total**	95.7	4.3
5.  keep locked away & out of reach of children	20.9	**Correct**	25.6	4.0
	47.8	**Partially correct**	54.4	24.0
	12.2	**Incorrect**	7.8	28.0
	4.3	**Critical confusion**	5.6	0
	14.8	**Don't know**	6.7	44.0
	100	**Total**	78.3	21.7
6.  dangerous/harmful to livestock & poultry	19.1	**Correct**	26.3	5.1
	23.5	**Partially correct**	28.9	12.8
	38.3	**Incorrect**	39.5	35.9
	1.7	**Critical confusion**	1.3	2.6
	17.4	**Don't know**	3.9	43.6
	100	**Total**	66.1	33.9
7. 30/12/2005  Expiry date	19.1	**Correct**	23.8	13.5
	1.7	**Partially correct**	0	3.8
	42.6	**Incorrect**	50.8	32.7
	13.9	**Critical confusion**	19.0	7.7
	22.6	**Don't know**	6.3	42.3
	100	**Total**	54.8	45.2

TABLE 42 (Continued):

8.  dangerous/harmful to fish & water bodies	11.3	**Correct**	16.0	0
	23.5	**Partially correct**	28.4	11.8
	45.2	**Incorrect**	46.9	41.2
	3.5	**Critical confusion**	2.5	5.9
	16.5	**Don't know**	6.2	41.2
	100	**Total**	70.4	29.6
9.  wear respirator	9.6	**Correct**	10.2	0
	8.7	**Partially correct**	8.3	14.3
	7.8	**Incorrect**	8.3	0
	2.6	**Critical confusion**	1.9	14.3
	1.7	**Don't know**	1.9	0
	70.4	**Mask**	71.3	57.1
	10.4	**Paper mask**	10.2	14.3
	100	**Total**	93.9	6.1
10.  Harmful	8.7	**Correct**	11.8	4.3
	23.5	**Partially correct**	27.9	17.0
	31.3	**Incorrect**	42.6	14.9
	0.9	**Critical confusion**	1.5	0
	35.7	**Don't know**	16.2	63.8
	100	**Total**	59.1	40.9

[1]"Wear boots and protective overall" was put as a separate category because although this answer is incorrect, a significant number of people gave this interpretation to warrant classification as a separate category.

6.2.3.1. Wear Gloves Pictogram (1)

The wear gloves prescriptive pictogram received the highest rate of correct responses (74.8 percent), and the least "don't know" responses (one percent). With three fourths of respondents understanding the FAO/GIFAP meaning, this pictogram appears to be the most comprehended as intended of the ten pictograms.

Some of the incorrect interpretations of this pictogram included:

- "After you have worked and ate, put the gloves on"
- "Wash your hands"

One respondent interpreted this pictogram to mean, "Take off gloves after working with pesticides". Although this implies that gloves were worn during spraying, the actual interpretation of the pictogram by the farm worker was an action of removing the gloves

after working, not putting on gloves before working with pesticides and wearing gloves while working with pesticides.

One critically confused interpretation stated "cover your hands when working with pesticides". On the outset the indication is that the person has understood the pictogram correctly. However, merely covering one's hands is not adequate to protect from pesticides penetrating the worker's skin on their hands. Not all gloves and hand covering are suitable to prevent permeation and skin absorption (i.e., gloves should be made of nitrile rubber, PVC, neoprene or butyl rubber, 90mm above the wrist, and have no lining; AVCASA 1996). Farm workers who do not have access to and cannot afford PPE, may cover their hands with a material that aids in and even increases absorption.

6.2.3.2. Wash After Use Pictogram (2)

The wash after use pictogram, also prescriptive, had the second highest correct responses (48.7 percent) from farm workers. This pictogram also had the least incorrect responses (4.3 percent) of all tested pictograms. Just under half of the study respondents were able to comprehend this pictogram as intended.

Some of the incorrect interpretations included:

- "It is poisonous"
- "Open the tap"
- "Wash your hands, lunch time"
- "To not use near animals and do not throw the wash water where the animals can drink it"
- "It is the tap with wash water"

A critically confused interpretation of this pictogram was, "wash your hands before you spray." Washing hands before spraying is a non-effective safety behavior as it does not aid in the immediate removal of spray residues on contaminated hands after

spraying. This interpretation implies a social and cultural rationality acquired from health professionals' campaigns in South Africa to persuade people to wash their hands before eating, touching food, breastfeeding, etc. The assumption may be that the hands are now "clean" and therefore will not be contaminated during spraying. The person may believe they do not need to wash their hands after spraying and may thus increase their exposure from pesticide residues on their hands.

6.2.3.3. Wear Boots Pictogram (3)

The "wear boots" symbol, again prescriptive, received the third most correct responses from 34 percent of respondents. The following discussion of the incorrect responses (22.6 percent) reveals some of the varied interpretations farm workers had for this pictogram. As previously stated, an "incorrect" response does not necessarily mean that it was an ineffective response in regards to safety behavior. Instead, it was an "incorrect" response in terms of the "expert" definition given by FAO/GIFAP. However, the point is that farm workers are interpreting pictograms differently from the FAO/GIFAP intended meaning. Thus the risk with the pictograms is that misinterpretations do occur and some misinterpretations can induce hazardous behaviors.

Examples of incorrect answers that could lead respondents to have effective safety behaviors are:

- "wear overall[58] and boots"
- "don't walk through pesticides"
- "wear overall and rubber gloves before working with pesticides"
- "wear protective shoes"
- "wear long pants when working in the fields"

[58] There is a separate icon (not presently used on South African pesticide labels) indicating that an overall must be worn.

- "do not walk bare foot near places where people work with pesticides"
- "do not let pesticide come into contact with skin"
- "cover your feet"

The following incorrect answers are instructing that boots be worn in specific circumstances, and potentially excludes other exposure scenarios (e.g., places other than the store room or field):

- "must wear overall and safety boots when walking through/in a sprayed field"
- "wear top-boots[59] and overall before going in the pesticides store room"
- "if you spray weeds, wear boots because it can get wet"

The following incorrect interpretations of the wear boots pictogram do not appear to give any indication that the definition will lead to a safety behavior that will promote protection against potential pesticide exposure effects:

- "walk across the road"
- "dangerous to pedestrians" & "pedestrians must be careful"
- "do not walk there" (this isn't a clear enough reference to imply a connection with places that have been sprayed)
- "you must walk with your feet"
- "must take caution where you walk (e.g., snakes)" (the example given has nothing to do with pesticides)
- "it is a man with top-boots"
- "footsteps"
- "a man"

One critically confused interpretation, "wear comfortable shoes", could potentially lead respondents to have a high exposure as "comfortable shoes" may imply highly absorbent shoes commonly worn by farm workers (e.g., sneakers, foot thongs). As with the

[59] "Top-boots" is what Afrikaans speaking people refer to as rubber boots. However, several people approached were unable to explain the origin of this term and why it is used.

response "cover your feet", the farm worker's feet could be covered with an unsafe, highly absorbing material.

6.2.3.4. Skull and Cross Bones Pictogram (4)

As previously stated, the skull and cross bones, a descriptive pictogram, elicits a high association with danger from respondents. In this study 30 percent of respondents had a correct response ("hazardous")[60], 59 percent were partially correct and eight percent gave incorrect responses. Approximately 18 percent of the respondents indicated this symbol meant death or lethal which was treated as partially correct. This means that although this symbol is for illustrating extreme hazardousness and does not indicate that the chemical is lethal or will lead to death, approximately 48 percent of respondents would understand an element of danger with regard to the pesticide in question. Although most of the responses included aspects of hazardousness such as danger, very dangerous, very toxic, and deadly, two incorrect responses were: "you are dead"[61]; and "dog eat bone".

6.2.3.5. Keep Locked Away and Out of Reach Pictogram (5)

Respondents gave the highest partially correct answers for this prescriptive pictogram at 49 percent. This pictogram has two meanings: (1) keep locked away, and

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[60] As explained in Chapter Four, in Afrikaans the definition for "hazardous" is tautological as it is translated into *gevaarlik* (dangerous; hazardous), *riskant* (risky; hazardous) and *gewaag* (dangerous; hazardous; risky). Although the technologically "correct" meaning of this pictogram is highly or extremely hazardous, I coded respondents who indicated the meaning as *gevaarlik* as correct although this word most often is used to refer to dangerous (see discussion in Chapter Five). That hazardous and dangerous are translate into the same word in Afrikaans highlights how the words used in English for hazard communication can be more non-committal. That is, according to the Concise Oxford Dictionary, hazardous means risk or dependent on chance, whereas dangerous actually means *causing* harm or risk.

[61] This comment was marked as incorrect as the coding of responses did not allow for broadening of the FAO/GIFAP intended meaning. However, this response could potentially lead to the FAO/GIFAP intended safety behavior if the respondent thinks one will be dead from the pesticide in question.

(2) keep out of reach of children. When respondents gave only one of these responses then their answer was marked "partially correct" (e.g., "pesticide places must be kept locked"). Only about one fifth of the respondents (20.9 percent) were able to give both correct meanings simultaneously.

- The 12 percent incorrect responses included:
- "bait in the orchard to see what kind of flies are in the orchard"
- "the women is pointing to the bottle of poison and it is locked away"
- "a women working with pesticide"
- "you must put holes in the empty can"[62]
- "sister"
- "looks like a bottle of chemicals"

One respondent's critically confused interpretation of this pictogram was: "every herbicide must be locked away". This view (discussed in Chapter Five) that some respondents perceive herbicides to be more toxic than other "pesticides", could lead this respondent to not lock away other pesticides (e.g., organophosphate insecticides) which are potentially more toxic than the herbicides used.

6.2.3.6. Dangerous to Livestock and Poultry Pictogram (6)

The dangerous/harmful to poultry and livestock symbol is a descriptive pictogram with a subtle proscriptive slant. That is, the information in the pictogram identifies that the particular pesticide is a hazard to livestock and poultry. However, the diagonal line across the pictogram makes the descriptive message appear proscriptive, but it is not

[62] This respondent is a general farm worker who sprays pesticides. From his other pictogram responses he seems to have a very basic understanding of pesticide safety. He has had some training which appears to have been basic about poisoning, the pesticides room and puncturing empty containers. Thus his interpretation of this pictogram seems to imply that he is making a visual association with what he has learnt (i.e., there are holes [the fence] and a container so he must put holes in the empty container].

explicitly clear and specified what action is prohibited other than not to expose livestock and poultry to pesticides. The visual reference to a cow and a chicken are meant to be a generic reference to livestock and poultry. Respondents generally were unable to generalize the meaning of this symbol to the broader range of the animal population as intended. There was some reference to just "animals" in general (i.e., encompassing all animals). In theory this interpretation is not problematic if it leads to behaviors that protect all animals from pesticide exposures, however the technological rationale for this pictogram is that livestock and poultry are particularly at risk.

This pictogram also depicts two meanings. Only 19 percent of respondents were able to give both meanings correctly; 24 percent gave partially correct responses, with 38 percent giving incorrect responses. Some of the incorrect responses with misleading or irrelevant interpretations for preventing poisoning of livestock and poultry were:

- "cattle walk on the road"
- "when driving, be careful of animals"
- "one cow and one chicken"
- "wash your hands before you milk the cow"
- "look around before you cross"
- "cow"
- "the cow gives milk and the chicken gives eggs"
- "danger"
- "it is wrong"
- "it is a chicken and a bull"

A critically confused interpretation given by two respondents was that this symbol meant that "the cattle must be dipped" and "you must put dip on the cow for the lice and fleas". As a risk communication mechanism, this pictogram is attempting to transmit information that this pesticide is particularly dangerous and harmful for livestock and

poultry; the action of using this pesticide for dipping cattle would put the animals at great risk of poisoning or possibly death. What this interpretation also illustrates is that respondents cannot necessarily differentiate that some pictograms (e.g., wear boots) give advice (i.e., are prescriptive) while others express warnings (i.e., are proscriptive), such as this pictogram. Clearly, the two critically confused responses given above interpreted this warning pictogram to be giving them advice on actions they should enact. These responses also highlight the lack of universal comprehension of the diagonal line in denoting a "do not do" or "dangerous/harmful" message.

6.2.3.7. Expiry Date Pictogram (7)

The "expiry" date symbol is used to draw attention to the expiry date which is printed in a box below this symbol. This pictogram is prescriptive in that it is meant to provoke the positive action of the end-user reading the expiry date and proscriptive in initiating behaviors of not using the pesticide beyond its expiry date.

For farm workers, exposure to expired pesticides can increase their health and safety risks when working with these pesticides as some expired products are potentially more toxic. Thus it is important that workers are able to identify whether a product is expired or not in order to protect their and others' health. However, only 19 percent of respondents provided the correct "expert" answer of "expiry date" and indicated that the pesticide should not be used after the date on the pictogram. Whereas, 43 percent of respondents gave incorrect responses, which was the highest incorrect response of the 10 pictograms tested. One incorrect response implied the pictogram was referring to a chronic health consequence associated with using the pesticide in question (i.e., "later in life pesticides will start affecting your body").

Interestingly, 14 percent of respondents gave critically confused responses, among which 10 percent of respondents indicated that this pictogram was illustrating the time when to spray the particular pesticide. This particular pictogram illustrates the arbitrary time as 5 to 12 o'clock for illustrating running out of time or more correctly, expired. Thus if the farm worker sprayed according to their interpretation of this pictogram, they may well spray during the hottest time of the day or when the wind is high and increase risk of exposure/poisoning and/or environmental contamination. As stated in Chapter Two, some pesticides can break down into more toxic substances when exposed to heat. Thus this critically confused interpretation of the pictogram could increase the workers' hazardous exposure and potential health effects.

Table 43 illustrates some incorrect responses given that would not provide safety information to the respondent relevant for the potential hazards from being exposed to an expired pesticide.

6.2.3.8. Dangerous to Fish and Water Bodies Pictogram (8)

This pictogram is used as a warning (i.e., descriptive) symbol to mean "dangerous/harmful to fish and water bodies" and again has a double meaning. Only 11 percent of respondents gave the correct FAO/GIFAP intended definition comprised of both meanings; 24 percent gave a partially correct response and 45 percent gave incorrect responses. This pictogram was found to be problematic as again it attempts to transmit two risk messages simultaneously.

Table 44 illustrates how when respondents did not know the correct definition for the pictogram, they made inferences from their social and cultural frame of reference.

TABLE 43: Farm Workers' Incorrect Interpretations of the Expiry Pictogram

Responses referring to general social/cultural references to time: • "a watch" • "time (shows the time)" • "five to twelve" • "watch the time" • "shows lunch time" • "when you do anything, you must look at the time"
Responses referring to work time: • "before lunch time, wash your hands" • "watch to show work time" • "how long you have worked with the pesticide" • "stopwatch for working hours" • "gives the time of how long you can work with the pesticide"
Responses referring to pesticide application and measurement practices: • "shows time when pesticide must be sprayed or used" • "the time taken to mix the pesticide" • "a scale to weigh (measure) or mix the pesticide" • "the time when you used the pesticide" • "the time it takes that the pesticide dries and the date of spraying" • "mix the pesticide at that time" • "you must spray with a watch on your arm" • "indicates the time to start and stop spraying" • "how much of the pesticide must be poured into the tank" • "beware of the time you are using the pesticide"
Social/cultural frame of reference response irrelevant for pesticide use • "don't walk during night"

TABLE 44: Incorrect Interpretations of Fish and Water Pictogram Not Provoking Relevant Safety Behaviors

Social/cultural interpretations of pictogram: • "a fish can is poisonous" • "do not fish here" • "dangerous when fish container is left open" • "dangerous to drink water and fishes" • "the fish that swims in the dam is dangerous to me" • "this is a fish with stripes" • "fish badge of Saddam Hussein"[63] • "the fish is swimming in the water" • "only one fish in the water; not for other fish" • "when you put the child in the water you must be careful" • "the fish must only be in the water and not outside on the ground"

[63] When asked how the respondent knew this, he said that he had seen Saddam Hussein wearing this badge on TV.

As stated, this pictogram is descriptive as it describes particularly that fish and water bodies are at risk from exposure to the pesticide in question. However, several respondents gave proscriptive, that is prohibitive behavior, interpretations. These included such statements as "don't throw pesticides in water or near fish", "do not wash the tanks near the river", "do not let the pesticide leak into the water", "do not fish here", "do not spray near fish" and "don't throw pesticides or pesticide containers in the sea or rivers." Most of these responses show insight on the part of study respondents in that they made inferences that would lead to safety behaviors that would protect fish and water bodies. However, this particular pictogram does not indicate what behaviors should be avoided (i.e., is neither intended to be prescriptive or proscriptive). Instead, it only provides a general, non-action specific, warning and potential hazard indication.

6.2.3.9. Wear Respirator Pictogram (9)

The "wear respirator" prescriptive pictogram received a 10 percent correct response, that is the responses intended by the "experts" at FAO/GIFAP. However, two extra response categories were added; "mask" which received 70 percent of responses and "paper mask", which received 10 percent. The reason for adding these categories was that this pictogram implies specifically that a respirator must be worn when using the particular pesticide. As the pictogram illustrates, a respirator is a breathing apparatus with two changeable filter cartridges which collect the toxic particles or droplets; whereas a mask is a paper "cup" covering the mouth and nose with the "cup" being the filter. Thus a respirator and mask are significantly different and have differing filtering capacities. However, many respondents either indicated that the pictogram meant "wear mask" or "wear mask to protect nose and mouth". From the responses given, it would appear that

when a respondent gave the response "mask", they were referring to a paper mask; however, as this was only implied and not clearly stated, only responses clearly stating "wear a paper mask" were marked under the "paper mask" category; the rest under just "mask". Through recoding this pictogram to separate respirator responses from mask responses, it became evident that approximately 80 percent of respondents believed that this pictogram implied a paper or dust mask must be worn with the pesticide in question. Two respondents, who at the time of the interview did not live on the farms where they worked, indicated that this "wear respirator" pictogram meant "a teddy bear".

Some of the critical confusions for this pictogram referred to "cover mouth so pesticide won't affect you" and "protect your nose so you don't inhale the pesticide." As with some of the other pictograms (e.g., gloves, boots) these comments would appear to imply protection from inhalation. However, as previously discussed, these inferences are open to the respondent using a barrier over the mouth or nose that is highly absorbent and may potentially increase the risk of exposure (i.e., a bandana type of cloth).

6.2.3.10. St. Andrew's Cross – Harmful Pictogram (10)

The "St. Andrew's Cross" is a descriptive symbol used to illustrate that the pesticide is "harmful". In addition, the signal word "harmful" always appears under this pictogram (see Appendix C). Of all the ten pictograms, only this pictogram is accompanied by a written equivalent to the meaning of the pictogram. Although the skull and cross bones signal words give an indication of hazard (i.e., "very toxic" and "toxic"), they do not exactly correlate to the definition as with this pictogram and signal word. However, in interpreting the St. Andrew's Cross, respondents gave the lowest FAO/GIFAP intended correct responses (8.7 percent) of all 10 pictograms and the highest

number of "don't know" responses (35.7 percent), despite the fact that the signal word "harmful" was directly under the pictogram. There are several potential reasons for why participants did not just read the signal word when providing a definition: (1) they did not notice the word; (2) they were unable to read the word; (3) they did not look at the label in their hands but at the interviewer's questionnaire guide which listed the pictograms as in Table 42 with no text; or (4) they relied on their own interpretations believing that the signal word had no significant relationship to the pictogram.

Table 45 illustrates respondents' incorrect responses (31.3 percent) for the St. Andrew's Cross pictogram. These interpretations are an apt illustration of how farm workers framed their interpretations to reflect the social and cultural context within which they live and work. That is, their mental processes were an act of recall of a previously seen and understood symbol that the St. Andrew's Cross resembled.

The following incorrect interpretations of the St. Andrew's Cross pictogram potentially provoke an acceptable (albeit not intended by the "experts") safety behavior. These are:

- "Don't touch because it is very toxic"
- "Don't come near poisonous substances, it is dangerous"
- "Don't spray near area where this sign is"
- "Don't work"
- "Means very dangerous, it is used for spraying roses"
- "Don't use, it is dangerous"
- "Do not eat or smoke before you have finished working with the pesticide"

TABLE 45: Social/Cultural Interpretations of the St. Andrew's Cross Pictogram

Associations with the Red Cross depicting first aid and medical help: • "first aid kit and telephone numbers of hospitals and clinics" • "first aid immediately" • "shows first aid ("*noodhulp*")" • "first aid in poison room" • "sick people, phone ambulance" • "Red Cross"[64] • "For emergency" • "shows hospital" • "It means you go to hospital"
Other social/cultural inferences: • "It is a headache, you must go to hospital" • "health sign" • "Star" • "A plus sign" • "Do not enter where this sign is shown"

The following incorrect interpretations of the St. Andrew's Cross pictogram potentially provoke an acceptable (albeit not intended by the "experts") safety behavior. These are:

- "Don't touch because it is very toxic"
- "Don't come near poisonous substances, it is dangerous"
- "Don't spray near area where this sign is"
- "Don't work"
- "Means very dangerous, it is used for spraying roses"
- "Don't use, it is dangerous"
- "Do not eat or smoke before you have finished working with the pesticide"

6.2.3.b. Discussion of Understanding Pictograms

As described in Chapter Three, the use of pictograms is meant to attract attention, improve warning comprehension for individuals with poor reading skills, minimize misperceptions of product hazards, and increase awareness of product hazardousness

[64] In Cape Town there is a government hospital called "The Children's Red Cross Hospital".

(Akerboom 1993). Industry and government expectations of what pictograms will accomplish as information transmitters are high, especially for semi-illiterate and illiterate populations (AVCASA 1996). There is an immense reliance on the interpreter "correctly" comprehending the "expert" intended meaning irrespective of their social/cultural context and frame of reference. From the results in Table 42, only for one of the ten pictograms did respondents give the expert intended correct response at a comprehension rate of over 50 percent (i.e., the wear gloves pictogram had 74.8 percent comprehension) and one pictogram had nearly a 50 percent comprehension rate (i.e., the wash after use pictogram; 48.7 percent). If, however, the partially correct responses are combined with the correct responses, the comprehension rates increased. However, the partially correct responses imply a partial understanding of the expert intended correct meanings and safety behaviors may also reflect this partial understanding. For example, one partially correct response for pictogram number 2 in Table 42, wash after use, stated that this pictogram meant "wash hands before eating because you have worked with a pesticide". However, the pictogram is implying wash immediately after using pesticides; whereas this partially correct interpretation could lead to some time lapse before hands are washed during which potential contamination/exposure could occur.

Table 42 also highlights that some pictograms appear to be better understood by farm workers (e.g., wear gloves, wash after use, wear boots, skull and cross bones) than others (e.g., dangerous to livestock and poultry, expiry date, St. Andrew's cross, keep locked away and out of reach of children). Those pictograms that were better understood were also more likely to be identified by farm workers as previously having been seen or noticed (see Table 42) and tended to be simple prescriptive pictograms without double

meanings. What is clear from the findings is that pictograms generally are understood by less than half of the farm workers indicating that these are not proving to be straight forward, stand alone, pesticide risk communication transmitters, especially for semi-literate and illiterate populations. Farm workers tend to have difficulty in generalizing from the pictures to the intended meaning. That is, pictograms appear not to be culturally neutral for universal use by diverse population groups.

The ethnographic findings illustrate that when farm workers did not know what the pictogram meant and could guess based on the picture, they relied on their social and cultural frames of reference for interpretations. The best example of this was pictogram number 10 in Table 42, the St. Andrew's Cross. An "X" is quite an arbitrary symbol and it was difficult for farm workers to infer from it the meaning "harmful". Instead respondents viewed this symbol to be more in the shape of a plus sign (+) for which there were several social/cultural references to first aid, hospitals, emergencies and a plus sign itself (see Table 44). This symbol is commonly found on many household products (e.g., cleaning materials) in South Africa and not only pesticides, however, what was clear from the findings is despite its breadth of use, comprehension was low. This also illustrates how pictograms are used as risk communication transmitters with the assumption of easy comprehension without target groups having prior information or training on pictogram interpretations.

On the one hand, respondents' incorrect and proscriptive responses for the St. Andrew's Cross pictogram (e.g., "don't touch", "don't work", "don't use") indicate that a message has been conveyed that this pesticide is harmful. Whereas, on the other hand, the technical developers (i.e., "experts") did not intend for pesticides with the St.

Andrew's Cross on the label to be avoided and not used. Furthermore, this interpretation could be particularly problematic for a farm worker if the farm owner or manager has instructed the worker to apply this particular pesticide. The misinterpretation could lead the worker to feel human rights violations that they are being "forced" to work with a pesticide that has a pictogram stating "do not touch or work with", along with the dilemma that they will lose their job if they refuse to work with this pesticide. Misinterpretations of pictograms can lead to fluctuating and conflicting pesticide risk perceptions that not only influence safety behavior outcomes, but social interactions (e.g., between employer and employee).

Another example of respondents relying on their social/cultural frame of reference for interpreting an unknown pictogram was an interpretation by two respondents that the "wear respirator" pictogram (number 9 in Table 42) meant "a teddy bear". This interpretation was purely based on a visual association and their interpretation bore no relevance in terms of provoking a safety behavior when using a pesticide. This challenges the "expert" intention of pictograms in being simple and easily understood cross-culturally when inferences have to be made. The fact that the other respondents who were living on the farm where they worked gave answers more in line with the intended meaning indicates that the living/social context is also an influence on the interpretation of pictograms (i.e., risk communication messages are contextualized). For example, even if farm workers do not work with pesticides they would "see" other workers with PPE, as well as have the influence of discussing and sharing information with one another. Another issue is that workers on the farm receive training whereas casual laborers supplied from an employment agency do not.

The findings also revealed that farm workers' predominately decide on the danger of a pesticide based on the pictograms on the label (e.g., skull and cross bones pictogram, PPE pictograms; see Table 41). The skull and cross bone pictogram, from the study findings, does appear to be an effective pictogram in representing danger/hazard for 52 percent of respondents. A unique future study would be to track the social history of the introduction and understanding of this pictogram and making comparisons between urbanized and developing countries as this symbol appears to have global relevance. The question is, why is this the case for this pictogram and not for others?

Several pictograms are meant to transmit not only one risk message, but two (e.g., numbers 5, 6, and 8 in Table 42). An example is pictogram number 8 in Table 42 where the message is dangerous/harmful to fish and water bodies. This concept that two seemingly related messages can be portrayed in one pictogram reflects the technological rationality of the pesticide industry (predominately from Western countries) that an association between the two messages (e.g., water bodies and fish) is straightforward irrespective of cultural bias. However the study findings revealed that only 11 percent of respondents were able to correctly identify both risk messages and only four percent were partially correct (i.e., correctly stated one of the two risk messages). Furthermore, Table 44 illustrates the social/cultural interpretations this pictogram provoked (e.g., "the fish tin is poisonous"; eating fish from tins is common amongst farm workers and this reference is potentially to food poisoning from leaving fish in opened tins). If pictograms are meant for illiterate populations and are intended by technological rationality to embody "simplicity", then making pictograms have double meanings is too complex and difficult

for that purpose. That is, the technical rationality of conferring upon pictograms two meanings appears problematic.

The social framing effect on the interpretation of pictograms was aptly illustrated by respondents' interpretation of the "wear respirator" pictogram (number 9 in Table 42). On further inquiry about why approximately 70 percent of respondents referred to paper masks rather than the respirator illustrated in pictogram 9, it became apparent that a common cultural practice on Western Cape farms is to provide farm workers with relatively inexpensive dust or paper masks (approximately US$2 per mask) rather than expensive respirators (approximately US$25 per respirator) which require regular replacement of two filters at a time (approximately US$5 per filter). On one of the farms participating in this study, a large table grape farm that had over 40 permanent workers, paper masks were regularly supplied to pesticide applicators for inhalation protection.[65] There is an indication from the study results that farm workers are aware of the need to protect themselves from inhalation especially as they themselves are, or they see other workers being, provided with protective masks (see the role of authority influences on perception of risk in Chapter Five). However, their understanding of the nature of the risk (i.e., the toxicity of the particular pesticide in use) was limited and their trust in authority figures who supply PPE was high; as a result, they accept and wear the paper masks they are given, even though the paper masks can be more dangerous than having no protection. That is, paper masks are highly absorbent which can increase inhalation risks through the absorption of particles or droplets floating or drifting in the environment

[65] This information came out during the training session held after administering the questionnaire (see Participatory Training as a Qualitative Method in Chapter Four). The Environmental Health Officer who had assisted with setting up the interviews, indicated that information would be given to the farmer that this practice was inappropriate and potentially dangerous.

(e.g., from granular dust or liquid vapors or spray drift). Paper masks become wet both through respiration and perspiration, as well as from the absorption of the actual pesticide itself. When paper masks are wet, particles stick more readily.

The use of the diagonal line on pictograms to illustrate a prohibited (i.e., proscribed) action is another good illustration of the pesticide industry's technological rationality for communicating risk. A diagonal line is not always a cross-culturally transferred symbol illustrating an unfavorable action. This was illustrated by some of the responses given to the two pictograms in this study with diagonal lines (i.e., pictograms 8 and 9), such as "the fish is swimming" or "the cattle must be dipped". However, a more pertinent point is that the proscribed behavior referenced by the diagonal line is not specified in the pictogram but is implied. Many respondents understood these pictograms to be illustrating a danger, but what the prescribed behavior should be was not clear. The problem is that (1) pictograms as a risk communication medium allow for limited transmission of information and (2) the technological rationale assumes that upon viewing the pictogram with its limited information, the receiver will intuitively act "appropriately". Again the varied responses to the livestock and poultry pictogram illustrate that farm workers had different interpretations of what behavior should follow after viewing this pictogram with a diagonal line on it. For example, "do not use pesticides where animals are", compared to "when sprayed the animals must not eat the grass". These behavioral interpretations may well protect these animals, but the issue is that industry is not committing themselves to what safety behaviors should be adhered to, making interpretation thereof a window of opportunity for industry to pass on liability.

The point above emphasizes the issue of pictograms categorized by their purpose, that is, whether they are descriptive, prescriptive or proscriptive. This study revealed that the category of intention by the technological rationality was often differently interpreted by the farm workers' cultural rationality. Furthermore, these categorizations are confusing as was illustrated above as often they do not imply how to enact the prescriptive or proscriptive behavior.

In summary, the research findings highlighted that farm workers framed their pictogram interpretations based on influences from cultural biases and social relations. As described in Chapter Four, farm workers have a unique social heritage of domination, poverty, subservience, and resulting social problems. An example of social context influencing pictograms would be the wrong provision of PPE because it is cheaper and farm workers will not speak up (e.g., interpretation of pictogram 9 as a mask instead of a respirator; see Cultural Theory in Chapter Three). Pictogram interpretations based on cultural and social influences resulted in several varied connotations and misinterpretations deviating from the intended technical mental model making the pictograms not understood cross-culturally. As stated, the intention (i.e., assumption) is that pictograms are "simple", straightforward and therefore easily understandable cross-culturally. However, the results in Table 42 illustrated that the farm workers' and experts' (FAO/GIFAP technical staff) cognitive tools (i.e., the integration of knowledge, attitudes, beliefs, impressions and images) differ and that the pictograms are not interpreted in line with the intended "simple" meaning, and are not readily cross-culturally transferred. That is, when comparing farm workers' interpretations of the ten pictograms in Table 42 with the intended (i.e., "correct") definitions of these pictograms

from the experts, for only one of the pictograms ("wear gloves") could more than half of the study respondents give the technological intended response. The ethnographic findings illustrated how pictogram interpretations sometimes lead to unintended but efficacious safety behaviors, whereas some interpretations are critically confused leading to potential unsafe behaviors. From the findings in Table 42 it can be concluded that pictograms are limited as transmitters of risk information because an inference of the information is required and that inference is influenced by cultural understanding (e.g., diagonal lines) and the use context.

6.2.4. Color For Toxicity

This section reviews the use of color on pesticide labels in order to illustrate the toxicity of the active ingredient. The subsections are: introduction to color literacy (section 6.2.4.1.), color blindness (section 6.2.4.2.), color code ranking (section 6.2.4.3), color code interpretations (section 6.2.4.4.), and discussion on cultural interpretation of color (section 6.2.4.5).

6.2.4.1. Introduction - Color Literacy

The FAO/GIFAP also developed color codes for descriptive use on pesticide labels to denote the toxicity of the active ingredient of the pesticide according to the WHO classification (based on LD50's[66]) of hazardous chemicals (see Chapter Two). In Southern Africa the colors used to represent the different levels of toxicity vary (e.g., Zimbabwe uses purple, red, amber and green; whereas South Africa uses red, yellow,

[66] LD50 is a technological rational approach for assessing toxicity based on the Lethal Dose (LD), i.e., the dose of the chemical necessary and sufficient to kill 50 percent of the animal population the chemical was tested on through different means of exposure (dermal, oral, ocular, and inhalation).

blue, green [listed in order from most to least toxic]).[67] The assumption behind using colors is similar to that of pictograms. That is, color is meant to cross the literacy boundary for communicating (transmitting) the potential hazard associated with exposure to a particular pesticide. However, even before one gets to the issues of the interpretation of color and the influences of culture thereon (see discussion section 6.2.4.5.), a prior concern in using color as a risk communication transmitter is the issue of color blindness.

6.2.4.2. Color Blindness

The use of color codes makes the technological rational assumption that visual transmission of "seeing" (i.e., receiving the color as intended by the "experts") will occur. For this reason farm workers were tested for color blindness. Each study respondent was presented with two Isihara plates and asked to decipher a number on them (question A-7 in Appendix A). This is the official technological rational color blindness test used by ophthalmologists. Of the 115 respondents, 114 read the numbers correctly. One respondent illustrated potential interpretive difficulties after reporting having seen a 20 rather than the correct 29 or incorrect 70.

Although in this study color blindness was not an absolute obstacle to comprehension, the point needs to be made that in the general population[68] there are individuals who are color blind, and that this impedes the effectiveness of using color coding as a means to communicate toxicity to the end user. According to the University of Cape Town's Ophthalmology Department, for the general world population, one in eight men and one

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[67] In South Africa, red represents hazard group Ia and Ib; yellow represents hazard group II; blue represents group III; and green represents hazard group IV.

[68] The Occupational and Environmental Health Research Unit (OEHRU) at the University of Cape Town has recently completed a study interviewing individuals from a broad spectrum of society (i.e., workers in

in 200 women are color blind (personal communication, Prof. Murray, 2003). One, therefore, needs to question the viability of color as a risk communication transmitter when 12 percent of the male population is potentially color blind and predominately the sprayers and applicators of pesticides are male. One also needs to question whether color codes could potentially lead to a riskier or unsafe behavior. If, for example, a farm worker had red-green color blindness, this worker would be unable to distinguish between the colors red and green (the two colors at the opposite ends of the toxicity spectrum on pesticide labels) and thus could potentially use a red labeled pesticide, thinking it was relatively safe, with little or no PPE.

6.2.4.3. Color Code Ranking

Approximately half of the study respondents (53 percent) knew that the color codes used on pesticide labels are for illustrating the toxicity of the pesticide[69] (see question E-10 in Appendix A). Fifty-one percent stated that color was indicating warning or danger, 11 percent did not know the purpose of the color codes, 2.6 percent thought it indicated the type of pesticide and 1.7 percent stated it represented the color of the pesticide company.[70]

In order to asses the viability of using color codes to illustrate variation of toxicity between different pesticides, respondents were provided with the four study labels and

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the chemical industry, agriculture and transport, as well as consumers) and found 12 percent of the 377 respondents were color blind (London et al. 2003).

[69] Perhaps a reason for 53 percent of respondents knowing what the color codes on labels represent despite only 48 percent knowing what a label is, is (1) that there is no correlation between identifying a label correctly and understanding the components of the label, and (2) as previously explained, the word "toxicity" is interchanged in Afrikaans with dangerous. Thus respondents may well have relied on their understanding that label components represent that the pesticide is dangerous and hence the color codes must show danger. Actual understanding of toxicity is difficult to assess from these study results because of the inter-changeability of the Afrikaans words and requires further investigation.

[70] Respondents were able to give more than one explanation as to what the purpose of the color codes is.

asked to put them in order from most dangerous to least dangerous. As the colors were part of the full labels respondents were able to use other label components as cues, in addition to color, to base their responses on. The reason for not presenting the colors in isolation of other label components was that, in context, farm workers in theory have access to the complete label with which to make their interpretations and the result would be testing only color and not the color code found on pesticide labels.[71] In this study, approximately 42 percent of respondents were able to put the color codes in industry's intended correct order (see Table 46). In ranking the four color codes from most dangerous to least dangerous, 84 percent listed red first; whereas 10 percent put a color other than red first as the most dangerous (see Table 46). Interestingly, four percent of respondents felt that all four colors represented the same level of danger.

TABLE 46: Farm Workers' Ranking of Color Coding Sequence (N=115)

Ranking From Most to Least Dangerous	Prevalence (%)
Red-yellow-blue-green ("expert" correct order)	41.7
Red-blue-yellow-green	13.0
Red-yellow-green-blue	12.2
Red-blue-green-yellow	10.4
Red-green-blue-yellow	4.3
Green-red-blue-yellow	3.5
Red-green-yellow-blue	2.6
Yellow-red-blue-green	1.7
Yellow-green-red-blue	1.7
Blue-green-red-yellow	1.7
Blue-green-yellow-red	0.9
Blue-red-green-yellow	0.9
All colors equally dangerous	3.5
Don't know	1.7

[71] In a previous study I conducted with farm workers in the Limpopo Province of South Africa, farm workers were provided with only four color squares and asked to rank these from dangerous to least dangerous. The result was that only 21 percent put these in the technological rational correct order and 79 percent failed to do so (Rother 2000).

6.2.4.4. Color Code Interpretations

Documenting what meanings farm workers associate with the different color codes is of importance for assessing the linkage between risk communication and behavioral intention. In this study, farm workers were asked, "what do the colors found on pesticides labels mean to you?" (question E-12 in Appendix A).

Respondents' definitions of the colors ranged, per color, from one end to the other of the risk danger spectrum. However, the red color tended to have responses mostly at the dangerous end of the spectrum. In defining the **red color code**, (ranked from high risk to little risk responses) the following was said:

- very toxic
- very dangerous
- deadly; can kill you; lethal
- I won't put my hands on it
- Very poisonous
- Do not touch anything before you have washed your hands
- Most dangerous pesticide
- Totally dangerous
- Very dangerous and keep out of reach of children (pictogram influence)
- Do not touch anything before you have washed your hands.
- Use on the farm

Emphasizing the point a bit more clearly that respondents' explanations of each color code ranged from one end of the risk spectrum to the other, illustrated here are some of the farm workers' ethnographic interpretations for the **yellow color code**, listed here in order from illustrating high risk to low risk:

- indicates danger
- just as toxic/poisonous as red
- very dangerous – do not spray near people and do not leave used clothes lying around at home

- harmful but not that poisonous
- must take caution; almost the same like red
- dangerous, but not as dangerous as blue
- doesn't look so dangerous
- less harmful
- it is lighter and not so dangerous
- not very poisonous

Responses for the **green color code** (also ranked from high risk to little risk responses) were:

- equally dangerous to the red one; must wear gloves because it is "fatty/greasy"
- just as dangerous and poisonous as red
- it is poisonous, but can't kill you
- it is dangerous, but not that much
- like blue; must wear PPE
- shows you must wear protection
- the yellow and the green is more or less the same
- less dangerous than yellow labeled pesticide; can spray near people
- least dangerous of them all but still must wear PPE
- this one is ok to work with
- not dangerous
- less harmful
- relatively safe – I will not get a fright

Responses for the **blue color code** (also ranked from high risk to little risk responses) were:

- very dangerous
- more dangerous than all the others [other colors]
- caution
- poisonous
- less dangerous than red but more than yellow
- mildly dangerous
- moderate harmful
- average toxic

- not so dangerous; blue and yellow are the same
- not very toxic
- blue and green more or less the same
- less dangerous and toxic than green
- not so dangerous because it is for fungi

When more than one color was present on the label, there tended to be confusion as to which color represented the expert intended color code. Generally the pesticide labels on agricultural chemicals have only had one color on them, usually a stripe representing the toxicity color code. However, domestically used pesticides (e.g., *Doom*, *Target*) generally have multi-colored labels for attracting attention with the toxicity color stripe at the bottom of the container or box.[72] In more recent years there has been an initiative to place an "herbicide compatible" color code on the labels as well. In this study, the yellow label (see Appendix C) had a purple rectangle in the right hand corner representing the herbicide group[73] this pesticide falls into; ten percent of respondents identified the purple herbicide code as the color code for toxicity rather than the intended yellow color.

Furthermore, the interviewers reported that several respondents identified and referred to the purple herbicide color code on the label (described in preceding paragraph) as red. This highlights the point that the technical rational differentiation between colors (purple and red in this case) may not be culturally recognized.

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[72]Pesticides used for agricultural purposes do not require fancy labels for marketing purposes. Instead industry representatives have an aggressive marketing strategy and many farmers accept the industry produced spray schedule. However, domestically used pesticides have to compete with one another. Thus industry relies on marketing and labelling strategies to attract potential buyers' attention.

[73] In South Africa, there is a move to reduce herbicide resistance through color code grouping of the herbicides to communicate modes of action and herbicide compatibility to farmers.

To highlight the social and cultural influence on risk communication, Table 47 illustrates some of the contextual associations made by farm workers in interpreting color code meanings.

TABLE 47: Context Associations of Farm Workers' Interpretation of Color Code Meanings

(N=115)

Question E-12: "What do the following colors found on pesticide labels mean to you?"

RED	YELLOW	BLUE	GREEN
- use on the farm	- very harmful, usually used to kill weeds	- this pesticide will start affecting your body after years of working with it	- for spraying in the field; use on fields
- used for spraying fruit trees	- it is used for grass	- use it on water	- use for grass or insects
	- use on the field	- prevention of disease	- means you can use it in dry lands or in summer when it is raining
	- it is lighter and not so dangerous	- not so dangerous because it is used for fungi	- it is life and not so harmful
		- used to spray weeds	- not so dangerous because the pesticide is more liquid

Signal words are used in conjunction with some color codes (i.e., red, yellow and blue) for the purpose of warning the reader of the label that this is a toxic product. Three signal words are used on South African pesticide labels (i.e., toxic or very toxic, harmful and caution). With the red color code, placed below the skull and cross bones are either the phrase "very toxic" (i.e., if the active ingredient is RSA[74] hazard group Ia) or the word "toxic" (if the active ingredient is RSA hazard group Ib). With the yellow color (RSA hazard group II), placed below the St. Andrew's Cross is the word "harmful". On the blue color code (RSA hazard group III), the word caution (without a pictogram) is

[74] Republic of South Africa.

placed between the handling of pesticides pictograms on the left side of the label and the advice/warning pictograms on the right of the signal word. An example of the effect signal words have on pictogram interpretations is that 26 percent of respondents cited the yellow color code as meaning "harmful" or relating to harmful, and 31 percent of respondents cited the red color code as meaning "very toxic" (the signal word corresponding to the red color code on the label in Appendix B). Therefore, for those arm workers who are able to read English or Afrikaans, the signal words appear to potentially function as a risk communication medium for indicating how toxic the pesticide is.

6.2.4.5. Discussion on Cultural Interpretation of Color

Farm workers' understanding of the color stripes on pesticide labels and color literacy was evaluated in this study in order to assess the effectiveness of color as a risk communication transmitter. An important aspect of color literacy is the issue of cultural interpretation and use of color. The English language embraces a wide range of terms to express even the subtlest of shades and variations of color (e.g., mauve, lavender, turquoise). However, in many African languages, color refers to social and cultural representations of the primary colors (e.g., blue as the sky, green as grass) which was evident in the findings of this research (see Table 47). One respondent remarked that the green color code on the pesticide label (see Appendix E) meant "grass", while another identified the blue color code to represent "beautiful". Several respondents identified the color green from their social context by relating it to the traffic light and defining green as "go" and "cars can drive when the light is green". Color thus becomes a social expression of the cultural environment.

Certain colors are difficult to translate from Western to non-Western cultures, such as oranges, browns, purples; these three colors in particular are often referred to as red. Shades of primary colors are not commonly expressed in African languages. For example, one of the labels used in this study has on it a yellow toxicity code, while in the right hand corner there is a purple rectangle used to illustrate the herbicide group[75] this pesticide falls into (see Appendix C). This confusion led 10 percent of respondents to identify the purple herbicide code as the color code for toxicity rather than the intended yellow color. Furthermore, the interviewers reported that several respondents identified the purple color on the label as red. This illustrates both a failure within the communication structure itself (i.e., which colors on the label are communicating what) and a confusion in the interpretation of the actual color itself.

Yellow, blue and green appeared to be ambiguous colors for toxicity coding that were interchanged with one another to represent degrees of danger (see Table 48 and definition of colors). There is, however, little ambiguity about the danger connotations of the color red as over four fifths of the participating farm workers identified red as representing the most dangerous pesticide. Presently color codes on pesticide labels in South Africa appear to serve the mere purpose of satisfying an industry requirement rather than serving as an efficient and effective transmitter for communicating the pesticide's level of toxicity to end users.

When asked to put the four labels in order from most dangerous to least dangerous (see Table 48), it became evident that many respondents were not making the assessment based on knowledge of the toxicity level each color code represented. Instead

[75] In South Africa, there is a move to reduce herbicide resistance through color code grouping of the herbicides to communicate modes of action and herbicide compatibility to farmers.

respondents made the decision of danger based on the pictograms or signal words on the labels. This was especially evident with the color red as the skull and cross bones pictogram is always placed with the red color code. This highlights the influence misinterpretations of pictograms potentially have on interpreting the colors. Although theoretically the influence of the pictograms and signal words on color codes is not problematic, this emphasizes the point that the technical rationality of simplicity and ease of these transmitter components is flawed. The color associations listed in Table 47 illustrate that not all farm workers necessarily equate color codes with a risk message; instead the association is with a use message related to their working environment on the farm (i.e., their cultural rationality).

Based on observations during interviews and comments from participants it became evident that farm workers in this study were not always aware that the color stripe at the bottom of the label was communicating risk information (i.e., a color code denoting toxicity). The labels used in this study present the color strip clearly without other colors (see Appendices B, C, D, and E). However many pesticide labels have several colors and pictures on them, and the color codes are often lost in these other colors and designs of the actual pesticide labels.

6.2.5. Comprehension of Precautionary Instructions

This section provides an analysis of the precautionary statements found on pesticide labels. This analysis is presented under the following subsections: introduction of interpretation of technical language (section 6.2.5.1.), burning of empty pesticide containers (section 6.2.5.2.), perforation of containers (section 6.2.5.3.), avoiding contamination of eating utensils (section 6.2.5.4.), dispose of wash water – safety

instructions lacking direction (section 6.2.5.5.) and discussion of comprehension of precautionary instructions (section 6.2.5.6.).

6.2.5.1. Introduction - Interpretation of Technical Language

As previously stated, the pesticide label has several components for communicating risk. As was illustrated, pictograms and color codes are limited in the amount of information they are able to portray. Precautionary statements are, therefore, intended to be brief concise texts (often a short sentence) usually providing prescriptive and proscriptive messages.

The ability of the receiver to understand the information as intended by the source of the information (e.g., technical scientists in developed countries) is an important influence on the ways in which and extent to which the communication process of precautionary statements affects the social amplification of risk. Thus, two key elements which influence and affect this transmission in the social amplification process are language appropriateness and verbal literacy.

Although technical experts assume that the language used on pesticide labels is commonly understood, many of the phrases used are "technical jargon" which are difficult or confusing for semi-illiterate or illiterate farm workers to understand and to interpret into an appropriate risk behavior (e.g., "copious" amounts of water or "perforation" of empty containers). In this section, findings are presented on the differences between the expert and lay frames of reference; these results highlight how these differences in frames of reference influence label comprehension and, specifically, comprehension of precautionary statements.

Pesticide labels in South Africa are written only in English and Afrikaans[76] despite the existence of 11 official languages.[77] However, not all pesticide labels in South Africa have both languages on them; some are written only in English. Thus the situation with the language on the pesticide label is such that, to be sure of comprehending all potential label information, the farm worker would have to be fluent in English. In this study, only 16 percent of respondents were fluent in English (see Table 48). The umbrella organization in South Africa for pesticide companies, AVCASA (Crop Life International South Africa, previously the Crop Protection and Animal Health Association), requires that member companies print pesticide labels in both English and Afrikaans. Although approximately 75 percent of pesticide companies in South Africa are represented by AVCASA, it is not clear what fraction of all pesticide containers these companies produce. Assuming that 75 percent of companies represent 75 percent of containers, Table 48 indicates that approximately 60 percent of farm workers were fluent

TABLE 48: Relationship between Ability to Read English and Ability to Read Afrikaans

(Question A-4 in Appendix A)

(N = 115)

(%)

		Can You Read English?			
		No	A Little	Very Well	Total
Can You Read Afrikaans?	No	13.9	3.5	0.9	18.3
	A Little	13.1	9.5	1.7	24.3
	Very Well	8.7	35.7	13.0	57.4
	Total	35.7	48.7	15.7	100.0

[76] The author is aware of one small company that has produced one pesticide label in Zulu. However, this is not a common language used by farm workers in the Western Cape.

in one or both label languages and thus could be sure of comprehending the information on 75 percent of the labels they might encounter. Table 48 also indicates that 18 percent of respondents were unable to read any Afrikaans, 24 percent could read "a little" and 57 percent were fluent. In terms of English, 36 percent were unable to read, 49 percent could read "a little" and 16 percent were fluent in English. What was unclear from the responses to this question was to what extent the respondents describing themselves as being in the "a little" category were able to comprehend the information on a pesticide label sufficiently to make an informed risk decision (i.e., execute an appropriate safety behavior). As the example in the following section (6.2.5.2.) shows, it is very difficult to measure fluency and language ability in a survey instrument where responses are heavily influenced by training and culture.

As literacy is a particularly vital link leading to safety behaviors for farm workers working with pesticides, Table 49 highlights the relationship between Afrikaans and English reading abilities for those farm workers who work with pesticides. Table 49 illustrates that just over half (i.e., 56.0 percent) of farm workers who work with pesticides

TABLE 49: Relationship between Ability to Read English and Afrikaans For Farm Workers Working With Pesticides
(N = 59)
(%)

WORK WITH PESTICIDES		Can You Read English?			
		No	A Little	Very Well	Total
Can You Read Afrikaans?	No	16.9	0	0	16.9
	A Little	22.0	5.1	0	27.1
	Very Well	6.8	39.0	10.2	56.0
	Total	45.7	44.1	10.2	100.0

[77] These are: English, Afrikaans, Ndebele, Sepedi, Sesotho, Swati, Tsonga, Tswana, Venda, Xhosa, and Zulu.

were fluent in one or both label languages and thus could be sure of comprehending the information on 75 percent of the labels they might encounter. Just under half of the study farm workers working with pesticides are unable to read (i.e., receive) the risk information provided in the label precautionary statements. Thus, language literacy capabilities of workers who work with pesticides are no better than, and if anything a little worse than, the capabilities of the workers as a whole.

Literacy issues are in terms of (1) being able to read the language on the label, and (2) being able to interpret and understand the technical language in order to follow through with a safety response. Although literacy rates in South Africa are pegged at approximately 80 percent of the population, what is unclear is if these literacy rates cover literacy competence in the only two languages labels are written in, and if the conceptualization of literacy extends to the comprehension of technical information found on labels.

6.2.5.2. Burning of Empty Pesticide Containers

To test respondents' aptitudes to receive and interpret technological risk information from precautionary statements, they were given the *Dithane M-45 800 WP* label (predominately the Afrikaans label was used; see Appendix D for the label in English), and asked if according to the label one should burn the pesticide container when it is empty. On the label under the list of precautions (see Appendix D), the very last statement states: "*Do not burn the empty container.*" Despite this, 53 percent of the participants replied yes that the empty container should be burnt (see Table 50). Only 32 percent of the respondents gave the correct response; whereas seven percent replied they did not know and eight percent were illiterate or unable to read the label (either because

of limited formal education or because they did not have literacy in the language of the label). According to Table 48, 18 percent of respondents cannot read Afrikaans, whereas here only eight percent of respondents reported illiteracy. This discrepancy highlights how some respondent relied on their previous knowledge/experiences (i.e., cultural rationality) to answer this question and did not rely on reading the label provided to them. In terms of literacy influencing comprehension, 56 percent of respondents who indicated they could read Afrikaans well indicated they would burn the pesticide container compared to 48 percent who were unable to read Afrikaans (Pearson's Chi-Square = 0.59; p-value = .743). This finding demonstrates that despite 56 percent of respondents indicating the use of pesticide labels for precautions (see Table 40), it is not purely a literacy issue which prevents respondents from receiving this proscriptive information on the label. Instead it illustrates that farm workers tend to not read the label, but rely instead on their self-efficacy and the influence of their social context.

TABLE 50: Belief That According to Label Pesticide Containers Should be Burnt

(N = 115)

(%)

Yes	**53.0**
No	**32.2**
don't know	7.0
Illiterate	6.1
can't read well	1.7
Total	100.0

With regard to the pesticide risk related behavior in Table 50 (burning the container), this particular belief is often passed on to farm workers by farm managers and owners in the form of an instruction to burn all pesticide containers. Agricultural extension agents and pesticide industry representatives in the Western Cape advise

farmers to burn their empty containers to prevent reuse and farm workers are tasked with the actually burning of these containers. One farm manager was unaware himself that some pesticide containers are not to be burnt due to the toxic nature of the pesticide and potential inhalation. On most of the study farms, farm workers pointed out to the researcher designated places for burning pesticide containers.

Pesticide container re-use is regularly practiced and is presently a health concern in South Africa. The technical statement on some labels in South Africa (discussed in Table 50), *Do not burn the empty container*, is intended to communicate safety behaviors that would avert the hazards of acute and chronic exposure to the fumes of the burning container and any residual pesticide. However, following this proscription leaves the possibility of acute and chronic exposure to the residual pesticide in the container if the container is used for drinking water or food (unless the label includes a prescription for perforation, see the following section). Thus, this is one example of many in which experts assume that lay people will understand technical jargon (if the label is read) and be able to perform the "appropriate" safety behavior. Clearly from the results in Table 50, over half of the study respondents were not able to execute this safety behavior based on the label's precautionary statement.

6.2.5.3. Perforation of Containers

On the blue label (Appendix D), under the precautions section, is the following technical statement: "*Destroy empty container by perforation and flattening and never use for any purpose.*" Respondents were asked what the word "perforation" (*perforeer* in Afrikaans) meant to them (see question E-21 in Appendix A) as the word itself is giving instructions for making holes into the container to prevent reuse. Of the 115 respondents,

only four percent knew what the word meant. The other 96 percent of the respondents had the following understanding of the word "perforation":

- 41.7 percent did not know what the word meant
- 39.1 percent had never heard of the word before
- 4.3 percent said it meant to bury the container
- 3.5 percent said it meant to recycle the container
- 2.6 percent said it meant to clean the container
- 1.7 percent said it meant to burn the container
- 1.7 percent said it meant to rot in the ground
- .9 percent said it meant to send the container back to the distributor
- .9 percent said it meant to crush the container

This list of respondents' understandings of the word "perforation" illustrates a social and cultural framing influence. For example, "clean container" illustrates the belief that containers can be reused and "burn container" illustrates the authority influence of instructing farm workers to burn all containers.

By using the technical word "perforation" for a prescribed behavior, 97 percent of respondents would have been unable to carry out the technologically intended safety action due to lack of comprehension of and familiarity with the actual word. This is an apt illustration of the use of a technical word, not used colloquially by farm workers, for prescribing an action and how the failure to understand technical jargon leads to no or an inappropriate safety behavior.

6.2.5.4. Avoiding Contamination of Eating Utensils

Another example of the technological rationality of experts conflicting with the cultural rationality of farm workers is the results from the following question based on the yellow label (see question E-17 in Appendix C): on this label under the precautions sections it states, "*Avoid contamination of food, feed, drinking water and eating utensils.*" Respondents were asked to explain what "eating utensils" are; 27 percent did not know what these were and 42 percent gave the correct intended response. Some incorrect statements which implied a confused understanding of the terminology (see discussion section for further explanation) included:

- It is when you are eating and driving while working on a tractor
- Food that you eat
- Fruit (apples, pears)
- Vegetables
- Drinking water
- Bread
- Meat
- Cleanliness
- When it is eating time
- Anything you can eat or drink
- Sweets, bubblegum – anything you can eat while working
- When the apple is ripe; when it is hanging in the tree

Some of these incorrect interpretations of "eating utensils" (e.g., food, meat, fruit, sweets) may not necessarily lead to hazardous behaviors, but at the same time will not provoke the prescribed behaviors (i.e., avoid pesticide contamination of apparatus used to eat with) as intended. The problem lies in farm workers' inability to correctly interpret what eating utensils are, whereby farm workers do not know that these utensils can be contaminated by pesticides and in turn harm them. This example nicely illustrates

cultural influences on interpretation of unknown terminology. The Afrikaans word for eating utensils (*eetgerei*) is technical and not commonly used and unfamiliar to farm workers. Therefore, farm workers inferred the word to mean something to do with food or eating, based on word association with the Afrikaans work for eat (i.e., *eet*). Consequently, when asked how to avoid contamination of eating utensils some respondents replied, "you must avoid vomiting when using the pesticide", "do not eat", "store meat in a refrigerator" and "before I work, I will eat and wash my hands".

6.2.5.5. Dispose of Wash Water - Safety Instructions Lacking Direction

As previously suggested, the technological rationality of the pesticide industry creates risk communication messages of three types -- descriptive, prescriptive or proscriptive. Prescriptive messages advising a specific course of action are also bound in technical jargon and subject to cultural interpretations. For example, on the yellow label (see Appendix C) is the following statement under the precautions section: *"Dispose of wash water where it will not contaminate crops, grazing, rivers or dams."* This statement gives an advice message of what not to do (proscriptive) but does not specify an acceptable/appropriate action of what to do (i.e., a prescription where to dispose of the wash waster). When respondents were asked to explain what "*dispose of wash water*" meant to them (question E-18.1 in Appendix A); 21 percent did not know what dispose of wash water meant. Approximately 74 percent of responses indicated some form of "throwing out", "getting rid of" or "destroying" the wash water. Table 51 illustrates the variations and interpretations of these.

TABLE 51: Respondent's Free Association of What is Meant by "Dispose of Wash Water"

Descriptive place of disposal	*Non-descriptive place of disposal*	*Proscriptive Action*
➢ "throw pesticide water in a drain" ➢ "throw the water in a toilet" ➢ "the water used to clean spray equipment must be thrown in a special drain" ➢ "throw water not just ➢ any place but where it can go to the sewage plant" ➢ "throw water away from vegetable plants"	➢ "throw water away" ➢ "get rid of it" ➢ "throw the water in a safe place" ➢ "to throw dirty or dangerous water away" ➢ "throw in a safe place away from animals" ➢ "throw away in a safe place because it can be reused"	➢ "water that was used to wash off pesticide must not be thrown in rivers or dams" ➢ "throw water safely away not near children playground" ➢ "don't use [water] again" ➢ "the water is dirty and full of pesticides and cannot be used again" ➢ "water that has come into contact with pesticides must not be left to stand"

The other five percent of respondents gave varied responses to what dispose of wash water means, such as:

- "to let the water run out from the bath"
- "it is poisonous"
- "you must not wash hands in running water"
- "be careful when you use the water again"
- "must use clean water"
- "the rainfall water is the right water"

Respondents were also asked to explain where they would "dispose" of this water so as not to contaminate crops, grazing, rivers or dams (question E-18.1(a) in Appendix A). Table 52 illustrates that 10 percent of respondents did not know what to do, another 20 percent suggested to throw it down the toilet, and 45 percent indicated that one should throw the pesticide water down a drain. According to the chemical industry (AVCASA and Crop Life International) and the South African government (Registrar for the National Department of Agriculture) no pesticides are to be thrown down any toilet

system (municipal toilet systems or long drops) or down any drains. Other responses from farm workers explaining of where to dispose of the wash water are illustrated in Table 52.

Study participants' responses to where the pesticide wash water should be disposed of (see Table 52) highlight the complexity of disposing of wash water, especially in a rural area of South Africa, the cultural interpretations of disposal and that the pesticide label does not give information or instructions of the acceptable approach to disposing of pesticide contaminated water. Also, some of the actions given by respondents for disposing of the pesticide wash waster are likely to increase environmental contamination and/or increase human exposure (e.g., down a drainage pipe, in a dam, in a toilet, in a drain, on the ground). As the pesticide label is not explicit in where to or where not to dispose of the water, the phrase is open to varied

TABLE 52: Perceptions of Where Pesticide Wash Water Should be Disposed Of
(N = 115)

	(%)
Throw the pesticide water down a drain	45.2
Down a toilet/pit latrine	20.0
On the ground; on grass; in bushes	3.5
In a field/vineyard	2.6
Make a hole in the ground and pour it in	2.6
In a dam	1.7
In a manhole	1.7
Special sink for rinsing spray equipment	1.7
On the grass or long grass where children don't play; where few people walk	1.7
In a sink at home	.9
Down the bath	.9
In an open space	.9
It must not be thrown outside	.9
To throw it where few people walk (e.g., where there is grass)	.9
Far away from trees	.9
In septic tanks	.9
Don't know	9.6

Respondents could give more than one response.

interpretations. Furthermore, the pesticide industry can imply that they have "warned" people about the danger of the contaminated wash water through their risk communication tool (e.g., the label) resulting in end users who throw the water down a toilet or a drain being liable for contamination.

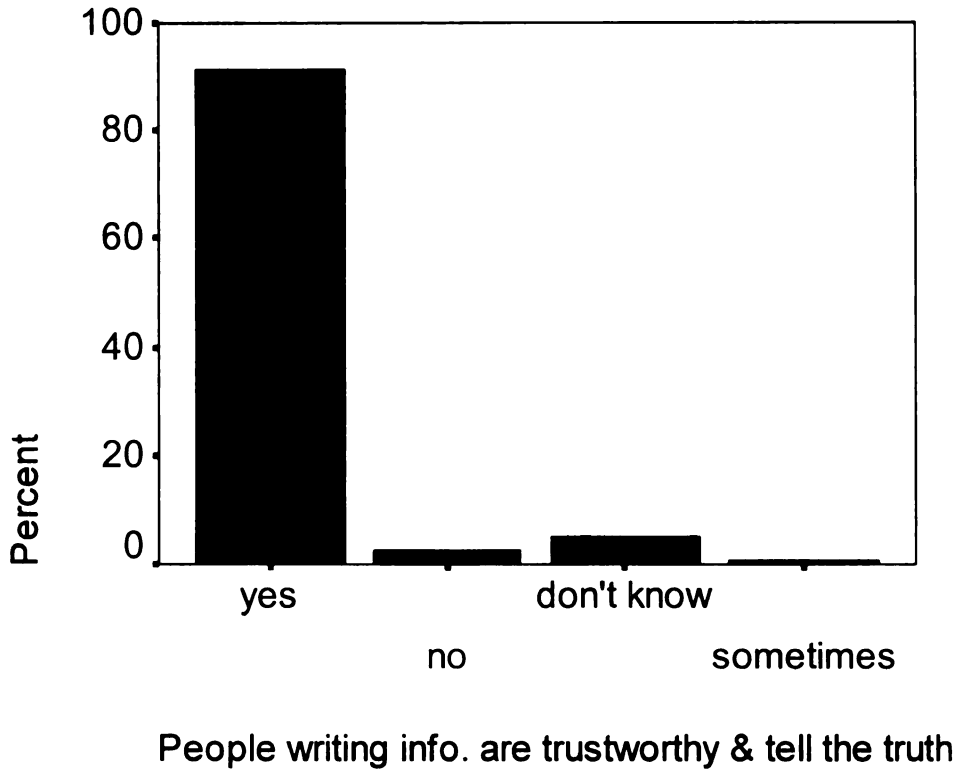
6.2.5.6. Discussion of Comprehension of Precautionary Instructions

The study findings indicate that the effectiveness of the use of precautionary statements on pesticide labels for evoking safety behaviors is impaired by the "experts'" use of technical jargon (e.g., technical words implying a prescriptive or proscriptive advice scenario often through use of one word such as "perforation" or "copious") and by the workers' literacy competency. Technical jargon used on pesticide labels, such as "perforation" or "eating utensils", illustrates the linear approach "experts" have to risk communication highlighted by Fischhoff's developmental stage 2 in Figure 7. Although precautionary statements appear to be short succinct proclamations of "appropriate" safety behaviors, the study findings illustrate that they are little understood.

6.2.6 Farm Workers' Trust in the Pesticide Label Information

A hypothesis presented in the risk communication and risk perception theory in Chapter Three was that when individuals lack information about risk, they rely on others whom they perceive as having the appropriate competence. In order to assess this concept of trust in authority and more specifically in those who develop pesticide labels, respondents were asked questions to assess what level of "social trust" they had in those who wrote the information on pesticide labels. Figure 16 illustrates that trust of the

Figure 16: Trust of Source of Pesticide Label Information



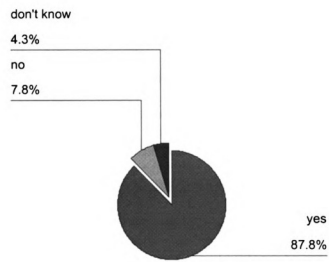
source producing pesticide labels is high amongst Western Cape farm workers (91 percent).

Figure 17 indicates that 88 percent of the study respondents felt there was no reason to distrust the information on the pesticide label and that this information is always correct.

6.2.6.1. Discussion of Social Trust of Pesticide Labels

Based on the findings from Figures 16 and 17, it can be generally concluded that the lack of effectiveness of the pesticide labels as a risk communication tool in South Africa is not related to farm workers' lack of trust in those who produce pesticide labels (i.e., the source; see Figure 7 in Chapter Three). That is, lack of trust does not explain lack of understanding.

Figure 17: Is the Information Found on Pesticide Labels Always Correct?



The literature on risk communication cites trust as an important element for effective risk communication to occur (see section on trust in Chapter Three). Furthermore, Margolis (1996) argues that risk communication problems stem from the lack of trust lay people have in scientific experts or expertise (see discussion in Chapter Three). However, it is argued in this study that "lay" people in developing countries have a different line on trust as there is not a culture of questioning the motives of industry or government. Thus trust in developing countries should not be necessarily viewed as a major element impeding effective risk communications.

For the general population, especially the rural population, exposure to debates about and within government and industry are limited. Generally, the lay populace has no reason to mistrust the information being disseminated. In this study, the trust of information was not limited to that of industry through the pesticide label, but was also evident in terms of pesticide information farm workers received from the farm manager,

the farm health and safety officer, the government environmental health officer, or a pesticide training agency. Thus this study identified what the researcher terms as a "blanket trust", that is, a trust in all sources of information on pesticides without reason to query or debate the validity of the information. What is interesting about this aspect of "blanket trust" is that even with mistrust and distrust having been part of the Apartheid era legacy in South Africa, there exists this general trust of information (e.g., from government, farmers, extension agents, health and safety officers, as well as pesticide labels). In a previous study (Rother 2000), small scale cotton farmers indicated that the government would not register any pesticide that was toxic or dangerous for people to use. That is, respondents' behavioral expectation (cognitive product) was that the South African government behaves in the manner they expect (i.e., not allowing the sale of hazardous pesticides).

6.3. FINDINGS AND DISCUSSION: OCCUPATION INFLUENCE ON PESTICIDE LABEL COMPREHENSION

The previous section reviewed the general findings of comprehension of the label components amongst all the study participants. This section, however, looks at whether occupation, and specifically working with pesticides, is a factor for increased comprehension of the label components.

Table 53 focuses specifically on pictogram comprehension in relation to whether the respondent was a sprayman, foreman, general worker, or spray tractor driver. As could be reasonably expected because of their experience, knowledge and access to information, foremen and supervisors had the highest number of correct interpretations (six out of ten, numbers 1, 4-6, 9 and 10; see Table 53), only three out of the six were

TABLE 53: Relationship Between Occupation and "Correct" Pictogram Interpretation

	Spraymen n=40	Foremen n=10	General Workers n=84	Drivers n=35	Total of all Respondents n=115
	(%)	(%)	(%)	(%)	(%)
1.  wear gloves	92.5 p = .693*	100 p=1.00*	94.0 p=1.00*	97.1 p=.674*	93.9
2.  wash after use	92.5 p=.538*	80.0 p=.279*	89.3 p=1.00*	88.6 p=1.00*	89.6
3.  wear boots	80.0 χ^2=5.91 p=.015	80.0 p=.490*	60.7 χ^2=2.79 p=.095	88.6 χ^2=12.1 p=.001	65.2
4.  hazardous & extremely hazardous (class Ia &Ib)	92.5 p=.538*	100 p=.596*	92.9 p=.083*	94.3 p=.340*	89.6
5.  keep locked away & out of reach of children	80.0 χ^2=3.65 p=.056	90.0 p=.168*	71.4 χ^2=1.08 p=.298	85.7 χ^2=6.78 p=.009	68.7
6.  dangerous/harmful to livestock & poultry	55.0 χ^2=3.85 p=.050	70.0 p=.095	45.2 χ^2=0.88 p=.348	68.6 χ^2=13.9 p=.000	42.6
7. 30/12/2005  Expiry date	27.5 χ^2=1.63 p=.201	30.0 p=.433	15.5 χ^2=5.49 p=.019	34.3 χ^2=5.48 p=.019	20.9

TABLE 53 (Continued):

8.  dangerous/harmful to fish & water bodies	50.0 χ^2=6.26 p=.012	40.0 p=.737	29.8 χ^2=3.46 p=.063	60.0 χ^2=14.1 p=.000	34.8
9.  wear respirator	92.5 p=.538*	100 p=.601*	88.1 p=1.00*	97.1 p=.105*	88.7
10.  Harmful	32.5 χ^2=0.00 p=.956	70.0 p=.012*	31.0 χ^2=0.21 p=.644	40.0 χ^2=1.41 p=.235	32.2

[1]Correct category = correct and partially correct responses; Incorrect category = incorrect, critical confusion and don't know responses

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

significant at or below the .10 level (numbers 5, 6, and 10). Although foremen and supervisors had a high percentage of correct responses, these were not all significant due to the small sample size in this occupational category. Tractor drivers had a higher percentage correct than the overall mean on nine of the ten items; five of these differences were significant at the .05 level. Drivers had the highest level of comprehension for three pictograms (numbers 3, 7 and 8); all of these were significant the .05 level. Spraymen did not have a higher comprehension level than the other work categories as one may have expected. In fact, spraymen had the highest level of comprehension for only one pictogram out of the ten (number 2, see Table 53), although not significant. They also had significantly higher correct responses than the total study sample for four pictograms (numbers 3, 5, 6 and 8) and insignificantly higher for on five (numbers 1, 2, 4, 7 and 9). However, this finding is not significant at the .05 level. The assumption is

that general workers should have the lowest level of comprehension as the other three work categories either work directly with pesticides or are involved with pesticide training (i.e., foremen and supervisors). However, general workers had the lowest level of comprehension for six out of the ten pictograms; of which three were significant at the .10 or lower level. These three pictograms (i.e., numbers 1, 2 and 4) were the top three most understood pictograms with all study participants (see Table 42).

In regard to pictogram comprehension, the picture in the pictogram seems to play a more relevant role in comprehension than the occupation of the worker. That is, there appear to be pictograms that are better understood for various reasons (e.g., more visibility, higher social/cultural association or more widely used in training) irrespective of the interpreter's occupational role.

In reviewing if the alert function of pictograms is influenced by a farm worker's specific occupational role, Table 54 presents findings on the percentage of workers who had previously seen each of the ten pictograms. Whereas in Table 53 foremen and supervisors had the highest correct interpretations of pictograms, in Table 54 this is not the case. There is no clear indication that one occupation notices the pictograms more than others. Instead foremen/supervisors and tractors drivers, and to a lesser degree spraymen, alternate and share noticing pictograms. What is clear, is that the pictograms had the lowest alert function amongst general workers for eight out of the ten pictograms (i.e., pictograms 1-3, 5, 6, 8-10); three of these were significant at the .10 level (i.e., pictograms 1, 6 and 8). Pictograms also had a lower alert function for general workers compared to the results for the total study sample for seven out of the ten pictograms (i.e., pictograms 1-4, 6, 8 and 10). Table 54 illustrates that those occupations that either work

with pesticides directly (i.e., spraymen and tractor drivers) or supervise/manage/train workers working with pesticides (i.e., foremen and supervisors) are more likely to have previously noticed the pictograms on pesticide labels.

Table 55 combines Tables 53 and 54 to assess whether the alert function of the pictogram influences comprehension amongst the various occupational roles. Foremen and supervisors who had previously noticed the pictograms had the highest correct interpretations of all the occupations, although their five highest percentages (i.e., pictograms 1, 4, 6, 9 and 10) was one fewer than above with the total sample. One of their top percentages was significant at the .05 level (i.e., pictogram 10) and one at the .10 level (i.e., pictogram 6). Consistent with the results from Tables 53 and 53, having previously seen a pictogram did not increase comprehension for general workers in comparison to the other occupational roles. Again, those occupations that in some capacity have contact with pesticides directly or indirectly, had a higher comprehension of pictograms they had previously seen.

TABLE 54: Specific Occupation Variation in Pictogram Alert Function Seen Before

1.  wear gloves	**Total Sample** (n=115) %	**Spraymen** (n=40) %	**Foremen** (n=10) %	**General Workers** (n=84) %	**Drivers** (n=35) %
	94.8	97.5 p=.633*	100 p=1.00*	92.9 p=.189*	100 p=.175*
2.  wash after use	91.3	92.5 p=1.00*	100 p=.597*	90.5 p=.727*	94.3 p=.721*
3.  wear boots	84.3	95.0 χ^2=5.27 p=.022	90.0 p=1.00*	82.1 p=.381*	94.3 χ^2=3.76 p=.052

TABLE 54 (Continued):

4.  hazardous & extremely hazardous (class Ia &Ib)	95.7	100 p=.161*	90.0 p=.371*	94.0 p=.322*	100 p=.321*
5.  keep locked away & out of reach of children	78.3	85.0 χ^2=1.64 p=.201	100 p=.115*	78.6 χ^2=0.02 p=.894	91.4 χ^2=5.13 p=.024
6.  dangerous/harmful to livestock & poultry	66.1	82.5 χ^2=7.37 p=.007	90.0 p=.161*	61.9 χ^2=2.43 p=.119	91.4 χ^2=14.4 p=.000
7. 30/12/2005  Expiry date	54.8	60.0 χ^2=0.67 p=.412	40.0 p=.344*	56.0 χ^2=0.17 p=.678	60.0 χ^2=0.55 p=.457
8.  dangerous/harmful to fish & water bodies	70.4	87.5 χ^2=8.58 p=.003	80.0 p=.721*	66.7 χ^2=2.13 p=.145	91.4 χ^2=10.6 p=.001
9.  wear respirator	93.9	95.0 p=1.00*	100 p=1.00*	94.0 p=1.00*	100 p=.099*
10.  Harmful	59.1	62.5 χ^2=0.29 p=.591	60.0 p=1.00*	57.1 χ^2=0.51 p=.475	62.9 χ^2=0.29 p=.591

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

Table 55: Occupational Variation in Comprehension of Previously Seen Pictograms

	Percentage Correct[1] Responses				
	Total Sample	**Spraymen %**	**Foremen %**	**General Workers %**	**Drivers %**
1.  wear gloves	96.3 (n=105)	94.9 p=.616* (n=37)	100 p=1.00* (n=10)	97.4 p=.320* (n=76)	97.1 p=1.00* (n=34)
2.  wash after use	91.4 (n=96)	94.6 p=.488* (n=35)	80.0 p=.205* (n=8)	90.8 p=1.00* (n=69)	90.9 p=1.00* (n=30)
3.  wear boots	71.1 (n=69)	78.9 χ^2=1.86 p=.251 (n=30)	77.8 p=1.00* (n=7)	68.1 χ^2=1.06 p=.303 (n=47)	87.9 χ^2=6.83 p=.009 (n=29)
4.  hazardous & extremely hazardous (class Ia &Ib)	90.0 (n=99)	92.5 p=.743* (n=37)	100 p=.594* (n=9)	93.7 p=.071* (n=74)	94.3 p=.497* (n=33)
5.  keep locked away & out of reach of children	80.0 (n=72)	91.2 χ^2=4.27 p=.039 (n=31)	90.0 p=.680* (n=9)	81.8 p=.554* (n=54)	90.6 χ^2=3.50 p=.061 (n=29)
6.  dangerous/harmful to livestock & poultry	55.3 (n=42)	63.6 χ^2=1.65 p=.198 (n=21)	77.8 p=.176* (n=7)	61.5 χ^2=2.62 p=.105 (n=32)	71.9 χ^2=6.17 p=.013 (n=23)
7. 30/12/2005  Expiry date	23.8 (n=15)	37.5 χ^2=4.01 p=.045 (n=9)	25.0 p=1.00* (n=1)	19.1 p=.177* (n=9)	42.9 χ^2=6.30 p=.012 (n=9)

Table 55 (Continued):

8.  dangerous/harmful to fish & water bodies	44.4 (n=36)	54.3 χ^2=2.42 p=.120 (n=19)	50.0 p=1.00* (n=4)	39.3 χ^2=1.96 p=.162 (n=22)	62.5 χ^2=6.98 p=.008 (n=20)
9.  wear respirator	89.8 (n=97)	94.7 p=.322* (n=36)	100 p=.594* (n=10)	89.9 p=1.00* (n=71)	97.1 p=.099* (n=34)
10.  Harmful	39.7 (n=27)	44.0 χ^2=0.31 p=.581 (n=11)	83.3 p=.033* (n=5)	37.5 χ^2=0.33 p=.565 (n=18)	50.0 χ^2=1.44 p=.230 (n=11)

[1]Correct category = correct and partially correct responses; Incorrect category = incorrect, critical confusion and don't know responses.

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

When evaluating the relationship between all workers who work with pesticides and pictogram comprehension, Table 56 illustrates as expected that those farm workers working with pesticides had a higher comprehension of the technological rational meanings of all ten pictograms than those who do not work with pesticides. Two of these were significant at the .05 level (i.e., pictograms 3 and 8); two were nearly significant at the .05 level (i.e., pictograms 5 and 7); and two were significant at the .10 level (i.e., pictograms 2 and 6). This was the case for nine out of the ten pictograms; with one tying (i.e., pictogram 10). Those workers who work with pesticides had a higher comprehension of the pictograms then the total study sample for nine of the pictograms and one was tied (i.e., pictogram 10). Thus the conclusion is that overall working with pesticides does increase pictogram interpretation. Yet again, the specific pictogram has a larger influence on correctness than does working with pesticides.

TABLE 56: Relationship Between Working With Pesticides and "Correct" Pictogram Interpretation

(n=115)

	Total of All Respondents	Work With Pesticides		Don 't Work With Pesticides
	(% Correct)	(% Correct)	(% Correct)	
1.  wear gloves	93.9	96.6	91.1	p = .264*
2.  wash after use	89.6	93.3	85.7	χ^2=1.73 p=.188
3.  wear boots	65.2	74.6	55.4	χ^2=4.68 p=.031
4.  hazardous & extremely hazardous (class Ia &Ib)	89.6	89.8	89.3	χ^2=0.01 p=.924
5.  keep locked away & out of reach of children	68.7	76.3	60.7	χ^2=3.32 p=.072
6.  dangerous/harmful to livestock & poultry	42.6	49.2	35.7	χ^2=2.12 p=.145
7. 30/12/2005  Expiry date	20.9	27.1	14.3	χ^2=2.87 p=.091

TABLE 56 (Continued):

8.  dangerous/harmful to fish & water bodies	34.8	44.1	25.0	χ^2=4.61 p=.032
9.  wear respirator	88.7	91.5	85.7	χ^2=0.97 p=.325
10.  Harmful	32.2	32.2	32.1	χ^2=0.00 p=.994

* A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

Table 57 looks at whether a specific occupational role influences the toxicological ranking of pesticide label color codes. The results, similar to Table 53, indicate that foremen and supervisors have a higher ability to rank the color codes as per the "expert" intention than the other workers, although not significant at the .05 level. General workers had a significantly lower comprehension level than all the other workers at the .01 level. Again spraymen had a lower comprehension level than expected. This again highlights the question about training differences between spraymen and tractor drivers and what other factors are influencing tractor drivers to have a higher comprehension level.

In general, Table 58 highlights that working with pesticides is not automatically equated with a higher ability to rank the color codes in their technologically correct order. Only 49 percent of respondents working with pesticides were able to rank the codes

correctly in comparison to 34 percent who did not work with pesticides (Pearson's Chi-Square = 2.74; p=.098).

TABLE 57: Correct Technological Ranking of Color Codes by Specific Occupation

	Spraymen n=40	Foremen n=10	General Workers n=84	Drivers n=35	Total Sample n=115
	(%)	(%)	(%)	(%)	(%)
Correct technological Ranking of Color Codes	45.0 χ^2=0.27 p = .605	60.0 p=.316*	34.5 χ^2=6.67 p=.010	51.4 χ^2=1.94 p=.163	41.7

* A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

TABLE 58: Correct Technological Ranking of Color Codes For Those Farm Workers Working With Pesticides

(N=115)

Work With Pesticides		Rank Order of Color Codes (%)	
		Correct	Incorrect
	Yes	49.2	50.8
	No	33.9	66.1

In evaluating occupation in relation to precautionary statements, Table 59 presents data on the specific occupational role and belief in whether the red labelled pesticide container could be burnt or not. Although not significant, farm foremen and supervisors had the highest correct response that these pesticide containers should not be burnt (30.0). Interestingly, general workers (29.8 percent), although not significant at the .05 level, were the second most likely to imply that the pesticide container should not be burnt. Whether this was read from the label or just an educated guess is not clear. However, what is clear is the authority influence on spraymen (25.0 percent) and tractor drivers (20.0 percent) instructing that all pesticide containers should be burnt.

Table 59 also illustrates that foremen and supervisors (60.0 percent) were more likely, although not significant, to correctly define eating utensils. Interestingly spraymen (42.5 percent) and tractor drivers (51.4 percent) were more likely to understand what eating utensils are than general workers (39.3 percent). In theory, occupation should not have an influence on comprehension of eating utensils as these are not work related tools. It is not clear why this variation occurred.

TABLE 59: Technologically Correct Response by Specific Occupation for Precautionary Statements[78]

	Spraymen	Foremen	General Workers	Drivers	Total Sample n=115
	(%)	(%)	(%)	(%)	(%)
Do not burn container	25.0 χ^2=1.45 p = .229 n=10	30.0 p=1.00* n=3	29.8 χ^2=0.83 p=.362 n=25	20.0 χ^2=3.42 p=.065 n=7	32.2
Definition of eating utensils	42.5 χ^2=0.02 p=.904 (n=17)	60.0 p=.316* (n=6)	39.3 χ^2=0.77 p=.380 (n=33)	51.4 χ^2=1.94 p=.163 (n=18)	41.7

* A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

Although not significant, Table 60 highlights that those working with pesticides (28.8 percent) were less likely to have the correct response that the pesticide container with the red label should not be burnt. This is in contrast to the 36 percent of workers not working with pesticides having the correct response that the pesticide container should not be burnt. Again, the findings could be illustrating the authority influence effect on

[78] "Perforation" was excluded as a variable for analysis from this table as only four respondents had the correct response. "Dispose of wash water" was also excluded as there is no technologically correct response provided by industry. That is, pesticide users are not informed as to where to dispose of the contaminated wash water.

TABLE 60: Technologically Correct Response of Precautionary Statements for Farm Workers Working with Pesticides

	Work With Pesticides (n=59) (%)	Do Not Work With Pesticides (n=56) (%)		Total Sample (n=115) (%)
Do not burn container	28.8	35.7	χ^2=0.63 p=.428	32.2
Definition of eating utensils	45.8	37.5	χ^2=0.81 p=.369	41.7

farm workers' working with pesticides who are instructed to burn all pesticide containers as a matter of a blanket policy.

Table 60 highlights that again, although not significant, workers working with pesticides (45.8 percent) had a better understanding of what eating utensils are than workers who do not work with pesticides (37.5 percent). Those working with pesticides also had a higher level of comprehension than the total study sample (41.7 percent).

6.4. FINDINGS AND DISCUSSION: GENDER INFLUNCE ON PESTICIDE LABEL COMPREHENSION

This section reviews the label comprehension findings in relation to gender. Specifically, this section analyzes whether there is a gender variation in the understanding for pictograms, color codes and precautionary statements.

Table 61 illustrates that there is a gender variation in interpreting the technological rational meanings of the ten pictograms in Table 42. For all pictograms except one (wear gloves) male farm workers had more correct responses than female workers. Of these, five were significant at the .01 level (i.e., pictograms 3, 6-9), one

TABLE 61: Gender Differences in Technologically Correct Interpretations of Pictograms

	Correct Responses			
	Total Sample (n=115) (%)	**Male** (n=69) (%)	**Female** (n=46) (%)	
1.  wear gloves	93.9	92.8	95.7	p=.700*
2.  wash after use	89.6	89.9	89.1	p=.100*
3.  wear boots	65.2	73.9	52.2	χ^2=5.75 p=.016
4.  hazardous & extremely hazardous (class Ia &Ib)	89.6	94.2	82.6	p=.063*
5.  keep locked away & out of reach of children	68.7	73.9	60.9	χ^2=2.18 p=.139
6.  dangerous/harmful to livestock & poultry	42.6	55.1	23.9	χ^2=11.0 p=.001
7. 30/12/2005  Expiry date	20.9	30.4	6.5	χ^2=9.56 p=.002

TABLE 61 (Continued):

8.  dangerous/harmful to fish & water bodies	34.8	49.3	13.0	χ^2=16.0 p=.000
9.  wear respirator	88.7	95.7	78.3	χ^2=8.33 p=.004
10.  Harmful	32.2	36.2	26.1	χ^2=1.30 p=.254

[1] Correct category = correct and partially correct responses; Incorrect category = incorrect, critical confusion and don't know responses

* A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

nearly at .05 (i.e., pictogram 4) and one at the .10 level (i.e., pictogram 5). For the wash after use pictogram, males and females had nearly the same rate of correct responses.

In general women's definitions of pictograms had less to do with pesticides and more with a wide-ranging concept from their broader social and cultural frame of reference (e.g., responses to the expiry pictogram: "don't walk during the night", "you must watch the time", "shows lunch time"). This appears to be affected by women's paucity in formal exposure to pesticide uses through training and information.

Table 62 looks at the relationship between gender and the alert function of having noticed the ten pictograms prior to the interview. Males had previously noticed eight out of the ten pictograms more than females (i.e., pictograms 1-6, 8, 9). Two of these were significant at the .01 level (i.e., pictograms 6 and 8) and two of these differences were nearly significant at the .05 level (i.e., pictograms 3, and 5). Interesting is that females indicated they had previously noticed the expiry date and St. Andrew's Cross pictograms

more than males. A reason for this could be that women tended to make more references to these in relation to their social context (e.g., first aid, emergencies, a watch) than males. That is, women used the act of recall based on their social framing of the pictograms to symbols commonly seen in their social environment and not to pesticide labels specifically. Whereas, males were not as likely to infer interpretations of these from their social context, but focused on the pictograms in the context of the pesticide label and thus did not perhaps notice them as much as females who inferred beyond the context of the pesticide label.

TABLE 62: Gender Variation of Pictogram Alert Function Seen Before

1.	**Total Sample** (n=115)	**Male** (n=69) (%)	**Female** (n=46) (%)	
 wear gloves	94.8	97.1	91.3	p=.216*
2.  wash after use	91.3	94.2	87.0	p=.195*
3.  wear boots	84.3	89.9	76.1	χ^2=3.96 p=.047
4.  hazardous & extremely hazardous (class Ia &Ib)	95.7	98.6	91.3	p=.156*

TABLE 62 (Continued):

5.  keep locked away & out of reach of children	78.3	84.1	69.6	χ^2=3.41 p=.065
6.  dangerous/harmful to livestock & poultry	66.1	82.6	41.3	χ^2=21.0 p=.000
7. 30/12/2005  Expiry date	54.8	47.8	65.2	χ^2=3.37 p=.066
8.  dangerous/harmful to fish & water bodies	70.4	88.4	43.5	χ^2=26.8 p=.000
9.  wear respirator	93.9	97.1	89.1	p=.114*
10.  Harmful	59.1	58.0	60.9	χ^2=0.10 p=.757

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

Table 63 illustrates the gender differences in comprehension of the FAO/GIFAP pictograms for those who reported previously having seen the pictogram in question. Overall, women who had previously seen the pictograms were less likely to have the correct definition for all pictograms except two (i.e., the wear gloves pictogram and wash after use pictogram); in neither case was the difference significant at even the .10 level. The differences were significant at least at the .10 level for six of the eight pictograms for

TABLE 63: Gender Variation in Comprehension of Previously Seen Pictograms

Percentage Correct[1] Responses

	Total Sample (%)	Male (%)	Female (%)
1.  wear gloves	96.3 (n=105)	94.0 p=.141* (n=63)	100 p=.006* (n=42)
2.  wash after use	91.4 (n=96)	90.8 p=.355* (n=59)	92.5 p=.120* (n=37)
3.  wear boots	71.1 (n=69)	77.4 p=.070* (n=48)	60.0 χ^2=3.59 p=.058 (n=21)
4.  hazardous & extremely hazardous (class Ia &Ib)	90.0 (n=99)	94.1 p=1.00* (n=64)	83.3 p=.548* (n=35)
5.  keep locked away & out of reach of children	80.0 (n=72)	84.5 p=.000* (n=49)	71.9 χ^2=5.35 p=.047 (n=23)
6.  dangerous/harmful to livestock & poultry	55.3 (n=42)	63.2 χ^2=8.66 p=.003 (n=36)	31.6 p=.484* (n=6)
7. 30/12/2005  Expiry date	23.8 (n=15)	36.4 χ^2=1.05 p=.305 (n=12)	10.0 p=.542* (n=3)
8.  dangerous/harmful to fish & water bodies	44.4 (n=36)	52.5 p=.259* (n=32)	20.0 p=.380* (n=4)

TABLE 63 (Continued):

9.  wear respirator	89.8 (n=97)	95.5 p=1.00* (n=64)	80.5 p=.295* (n=33)
10.  Harmful	39.7 (n=27)	45.0 χ^2=3.17 p=.084 (n=18)	32.1 p=.315* (n=9)

[1]Correct category = correct and partially correct responses; Incorrect category = incorrect, critical confusion and don't know responses

*A Fisher's Exact Test was used to calculate this p-value as one or more cells contained less than five respondents.

which males were more correct than females (i.e., pictograms 3, 5-9). There were significant differences between males' and females' correct answers at the .01 level for four of the ten pictograms (i.e., pictograms 6-9). Comparing Table 63 with Table 62, that is restricting the comparison to aware males and females, reduces the male superiority in correctness and in two cases this causes females to be more correct than males (i.e., pictograms 1 and 2).

Table 64 looks at the question of whether there is a gender difference in ranking color codes in the technologically correct order. According to the study results, half of the study males (50.7 percent) were able to put the colors in the correct order in comparison to only slightly over a quarter of the females (28.3 percent). These findings illuminate the possibility of the effect of males predominately receiving pesticide training as was illustrated in Chapter Five where only 8.7 percent of females were training in comparison to 53.9 percent of males. As so few females have received training, it is not possible to conduct a reliable three-way cross tab between gender, training and correctness.

TABLE 64: Correct Technological Ranking of Color Codes Between Females and Males

Gender		Rank Order of Color Codes (%)	
		Correct	Incorrect
	Female (n=46)	28.3	71.7
	Male (n=46)	50.7	49.3

In evaluating gender differences with precautionary statements, Table 65 highlights that females (34.8 percent), although not significant, were more likely to have the correct response that the red labeled pesticide container should not be burnt than in relation to males (30.4 percent). Males having received more training than females, were more likely to be told to burn pesticide containers rather than have read the label. However, this result does not necessarily indicate that females read the red label.

However, Table 65 indicates that males (46.4 percent), although not significant, were more likely than females (34.8 percent) to have the correct definition of eating utensils. It appears coincidental that the same percentage of females replied correctly for burning the container and eating utensils.

TABLE 65: Technologically Correct Response of Precautionary Statements between Females and Males

	Female (n=46) (%)	Male (n=69) (%)		Total Sample (n=115) (%)
Do not burn container	34.8	30.4	χ^2=0.24 p=.625	32.2
Definition of eating utensils	34.8	46.4	χ^2=1.53 p=.217	41.7

6.4.1. Gendered Variation in Label Comprehension

The previous findings illustrated that there is a gendered differentiation in the interpretation of the pesticide label components. Perhaps the question to be asked is whether female farm workers need to understand pesticide risks and ultimately, pesticide labels. The answer to this would be the affirmative based on women's unrecognized work that exposes them to pesticides. That is, they need to understand exposure, avoiding exposure, re-entry intervals, waiting periods before harvesting, handling pesticide clothing, cleaning spray equipment, mixing pesticides, and at times, spraying. Thus, women do need to be able to read and understand pesticide labels because any female farm worker at any time may be instructed to do pesticide related tasks (see Chapter Five).

6.4.2. Gender Neutrality

As illustrated in Chapter Three, risk communication tools are designed to transmit technical hazard information universally and cross-culturally. However, one needs to ask whether risk communication tools are gender neutral and applicable in all gendered contexts? That is, are there circumstances in which women and men need to be given different hazard information specifically relevant to gender? Or does the present hazard information on labels suffice to cover various gendered needs? In order to explore these questions, a closer look at some gender specific health circumstances is required.

6.4.2.1. Female Farm Worker Health Issues

Under the precautions section of many pesticide labels is often the following statement: "*Do not eat, drink or smoke whilst mixing, applying or before washing hands*

and face." One female respondent, after being asked when one should wash one's hands in order to reduce the harmful effects of pesticides replied "before breast feeding"; while another woman replied with, "before picking up a child". Although the pictogram for wash after use (see number 2 in Table 42) is blanket coverage for washing before anything is touched, the text part written on the pesticide label quoted above is more specific and limiting. Breast feeding before washing hands after the person came into contact with a pesticide (e.g., harvesting, cleaning equipment, cleaning a pesticide store room, carrying containers to be burnt) is a potential source of contact exposure for a breast feeding infant. Although this particular respondent called attention to this issue, this is not an issue that has been highlighted or even recognized by industry or pesticide trainers.

6.5. CONCLUSION

The statistical and ethnographic evidence of this research leads one to argue that pesticide labels are not well comprehended by farm workers and that the present risk communication system (industry → label → workers) is not an effective risk management strategy for protecting South African farm workers' health from pesticide exposures. Many of the study farm workers had not used a pesticide label for hazard information previous to the interview nor were they aware that the pesticide label provided more information than use and measurement information, precautions and what PPE to use. Furthermore, approximately 50 percent or more of the respondents had misleading, incorrect and critically confused interpretations of the label pictograms, color codes and precautionary statements. Interpretations were not based on a technical

rationality of simplicity, but instead influenced by the social, cultural, political, historical, economic context of the person interpreting. One could thus argue that pesticide labels are a poor transmitter of pesticide safety behavior and are not an adequate risk communication tool for the South African context, and more specifically, for farm workers.

From the responses farm workers' gave in terms of their understanding of the technical meanings of the pictograms, color codes and technical jargon, it can be concluded that these are not culturally neutral; instead inferences were made based on the farm worker's cultural rationality influenced by their social/cultural context. This was nicely illustrated by the descriptive interpretations of pictograms and technical jargon, as well as the cultural references to color. A good example was the "dangerous to fish and water bodies pictogram" where many farm workers' interpreted this to refer to some aspect of fishing.

The pictogram interpretations highlight that social and cultural framing influences affect farm workers' understanding of the pictograms and that the pictograms are not neutral or universally applicable. The St. Andrew's cross pictogram is a good example of this where many respondents interpreted the cross to represent something to do with a hospital, first aid or emergency as a thick red cross is used in South Africa to symbolize these.

Technical rationality views visual literacy as a context-neutral process that is viable for replacing language literacy. However, visual literacy needs to take into account the attributes of individuals within varying cultural and social contexts making interpretations, as well as the attributes of the message to be interpreted within different

social, cultural, political, historical and economic contexts, as these influence interpretations. Authority influences are one example, highlighted in this dissertation, of a context influence. As was illustrated, farm owners general supply workers with paper dust masks and not respirators. Thus the pictogram for "wear respirator" was predominately interpreted to mean "wear mask". The findings of this study illustrate that visual literacy is not context or culturally neutral.

From the interpretations of various pesticide pictograms, it is evident that pictograms meanings are contextualized and do not always reflect the intended meaning. Nevertheless occasionally an unintended interpretation still provokes an effective safety behavior; while other times it evokes an irrelevant response. While some interpretations actually put the individual, others or the environment at risk if the farm worker implements the incorrect interpretation. The universality of pictograms, as assumed by the experts, is highly questionable. It is argued that (1) without training, risk communication tools have limited cross-cultural effectiveness in promoting safety behavior, and (2) even training neither guarantees the intended comprehension nor ensures the anticipated safety behavior. For example, being able to correctly state what a pictogram means does not indicate a correct safety behavior outcome or implementation of an action intended.

A concern identified by this study is the problem with pesticide labels serving multiple purposes. Pesticide labels do not only present risk information in the form of pictograms, color codes and precautionary statement, but are also comprised of, for example, information on directions for use, mixing instructions, compatibility with other pesticides, application directions, aerial application, application rates, pest resistance

statements, warnings, symptoms of human poisoning, first aid treatment, note to physician, re-entry intervals, when to harvest after spraying and emergency contact details. A document of this nature with so much diverse information on it leads to confusion and misinterpretation of information. Future research on the improvement of pesticide labels as a risk communication tool should take into account this diverse role it plays and analyze appropriate methods for presenting risk information in isolation of other perplexing information.

The theory of social amplification of risk posits that risk information is provided by a source and transmitted to receivers. This theory further hypothesizes that a "ripple effect" will occur with the risk information being further transmitted from individual to individual and organization to organization. What the theory of social amplification does not take into account, what has been highlighted by the findings of this research, is that transmitter stations (e.g., humans [farm workers], organizations) do not necessarily receive the message as intended by the source of the information (e.g., "experts" technological rationality [technical developers of pesticide labels) and that the message is then further transmitted in an altered state (i.e., affected by the receivers' cultural rationality). What is of interest, which social amplification theory does not address, is the effect of the altered message has on behavioral intentions and perceptions of risk. The findings of this chapter challenge the linear assumption of risk communication in social amplification theory and demonstrate that cultural rationality and technological rationality are not homogenous; thus resulting in risk attenuation and altered risk messages.

Chapter Two highlighted the legality status of pesticide labels in South Africa and industry's attempt to place onus and liability on end-users through stating that poisonings, inappropriate applications, non-target exposures and contaminations, etc. are a result of the end-user failing to comply with and read the label as all the necessary risk information is present on these. Professor Gerhard Verdoorn, Director of Birdlife South Africa, recently voiced a common attitude in South Africa by stating: "Pesticide manufactures are bound by law to print warnings and precautions on their labels but of course we can expect that in many cases the public do not read and follow the advice presented on the labels" (Verdoorn 2004). This sentiment is supported by industry, government and others who adhere to the technological rationality that pesticide labels are a sound and viable risk communication tool (i.e., a *fait accompli* endorsed by the law) and it is the end-users who are unsound and to blame. However, the findings of this chapter illustrated that this technological rationality needs to be challenged and questioned. Furthermore, through the analysis of each risk communication medium on the pesticide label (e.g., pictograms, color codes, precautionary statements) this chapter demonstrated that risk communication as technologically intended does not occur through the pesticide label, particularly with farm workers. The research findings also elucidate human rights issues. That is, does provision of risk information implicate social responsibility for provision of comprehension of this information? Does the pesticide industry have the right to sell products that are intrinsically toxic when this toxicity is not understood by the populations using it? Does the provision of risk information (i.e., the right to know) equal the right to understand?

CHAPTER SEVEN

THE INTERACTION OF RISK COMMUNICATION AND RISK PERCEPTION

7.1. INTRODUCTION

Chapter Three highlighted that risk perception theories attempt to understand human perception of risk either from the perspective that risk itself is deterministic in generating perceptions (i.e., the psychometric paradigm and value expectancy models) or that the cognitive characteristics of the perceiver are central to understanding risk perceptions (i.e., cultural theory, heuristics). Also in Chapter Three it was emphasized that risk communication, a field born out of Western governments' desire to overcome public opposition to risky concerns and to appear to be involving the public in decision-making, relies on risk perception research in order to gauge and structure risk communication strategies.

The literatures of these two fields become intertwined when the focus is placed on understanding perceptions (i.e., through the research findings presented in the literature) in order to develop what is deemed as "appropriate" risk communication strategies. What the literature fails to address, that is highlighted in this research, is how the social construction of risk and therefore risk perception, also in turn implies the social construction of risk communication; that is risk perceptions influence both how risk communication strategies are used, and how they are perceived. To further discuss this, the first two findings chapters of this dissertation (i.e., Chapters Five and Six) provided an analysis of the content and determinants of farm workers' pesticide risk perceptions, and an analysis of farm workers' understandings of the pesticide label components as

pesticide risk communications. This third findings chapter uses the variables discussed in the previous two chapters, to assess (1) whether there is an interaction between farm workers' pesticide risk perceptions and pesticide risk communication (i.e., the pesticide label), and (2) if this interaction influences the effectiveness of risk communication tools as has been hypothesized in this dissertation.

This chapter starts by examining whether, at the simplest level, there is some aspect of an interaction between risk perception and risk communication, and whether some prior common cause can account for that interaction. After establishing that such an interaction exists, the chapter then endeavors to tease out some rudiments of that interaction so as to move beyond this simplest level of connection. To achieve this, risk perceptions and risk communication are elaborated by using a factor analysis approach. The interaction investigation process is concluded by conducting a correlation analysis to investigate which components of risk perception have significant linkages to which components of risk communication. Although correlation analysis does not by itself prove causality or indicate the direction of influence, it can offer insights into the ways in which risk perception and risk communication are influencing each other. By investigating the interaction between risk perception and risk communication (including the influence of gender and working with pesticides on this interaction) the intention is to provoke thought and further research on this linkage between the two, along with stimulating discussion so as to improve the effectiveness of present risk communication strategies. The assertion is that by understanding this interaction, light will be shed on:

1) the limitations of pesticide labels as a risk communication tool evoking intended safety behavior for both human health and environmental protection (i.e., effective pesticide risk management); and

2) the importance of researching risk communication and risk perception issues jointly, especially for effective risk communication tools.

7.2. INTERACTION ANALYSIS

7.2.1. Variable Representation for Risk Communication and Risk Perception

To evaluate if there is a statistically significant interaction (i.e., linkage) between risk communication and risk perception, I first created variables representing each based on the findings from Chapters Five and Six. For the "risk perception variable" I reviewed the variables used to measure risk perception in Chapter Five. Table 66 presents the 15 items selected to represent perception based on the questions from the study questionnaire found in Appendix A.

I then ran a Cronbach's alpha for an index including these 15 variables to test for reliability. Cronbach's alpha is a test of reliability (or consistency) which measures how well a group of items (or variables) measure a unidimensional latent construct; it is not a test of significance. The alpha score for the risk perception variable is .63[79] (see Table 66) which indicates the 15 variables for risk perception are fairly "reliable" as a group representing risk perception based on the alpha scale reliability analysis.

For the "risk communication variable" I reviewed the variables used to measure risk communication in Chapter Six, selecting 13 items assessing comprehension of the pesticide label based on questions from the questionnaire in Appendix A (see Table 67). The Cronbach's alpha for an index including these 13 variables was .65[80] which indicates

[79] Removal of any of the 15 risk perception variables actually reduced the alpha score below .63. Consequently, all variables were retained for the alpha test.

[80] Removing the variable for ranking technologically correct color codes raised the alpha to .71. Removing this variable together with the variable for the wash hands pictogram raises the alpha to .72.

that the 13 variables representing risk communication are reliable, that is they are measuring a single underlying construct.

TABLE 66: Description of Risk Perception Variables

Variable Name	Description of Variable	Question number in Appendix A
POISONOUS	Belief that all pesticides are poisonous	B-6
DANGEROUS	Belief that all pesticides are dangerous	B-7
RANKPEST	Pesticides are ranked as more poisonous than dirty water, headache tablets and petrol	B-2
PESTSPRAY	Spraying pesticides is ranked as more dangerous than smoking and drinking	C-1.1
WORKPEST	Working with pesticides is ranked as more dangerous than exposure to snakes and TB.	C-1.2
CHILDPLAY	Child playing in sprayed field is ranked as more dangerous than swimming and breathing in cigarette smoke.	C-2
ACUTE	Belief that all pesticides can make you sick straight away	C-12-1
CHRONIC	Belief that some pesticides can make you sick years from now	C-12-2
CHILD	Belief that pesticides can harm the health of worker's children	C-5
ALLSICK	Belief that all pesticides can make you sick	C-11
HARMSELF	Belief that pesticides can harm own health	C-3
COWORKER	Belief that pesticides at work can harm co-worker's health	C-6
FETUS	Belief that pesticides can harm health of fetus	C-8
FERTILITY	Belief that pesticides can affect workers' ability to have children	C-9
PPEFULL	Belief that PPE protects you from all possible pesticide health effects	F-5

Response format: Bivariate (1=belief yes; 2=belief no)

7.2.2. Correlation Test Between Risk Perception and Risk Communication

After establishing that the created variables for risk perception and risk communication were reliable, a correlation test was run with these two variables to determine whether there is a relationship between the two. The resulting association is a weak positive correlation between the two variables with a Pearson's correlation (r=.304) significant at the .01 level. Table 68 presents a scatterplot of this correlation. The concept with the scatterplot is that the closer the dots are to the diagonal line drawn in the

TABLE 67: Description of Risk Communication Variables

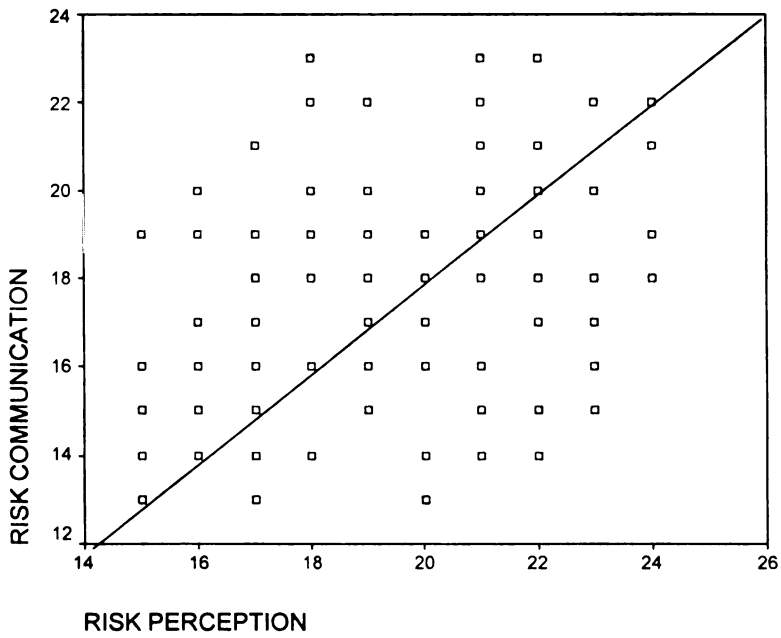
Variable Name	Description of Variable	Question number in Appendix A
CONTAINER	Belief about burning red labeled pesticide container	E-20
CORRECTC	Technologically correct ranking of four pesticide label color codes from most to least dangerous	E-7
UTENSILS	Definition of eating utensils	E-17.2
GLOVEPIC	The wear gloves pictogram (#1)[1]	E-9.2
HANDPIC	The wash after use pictogram (#2)[1]	E-9.1
BOOTSPIC	The wear boots pictogram (#3)[1]	E-9.4
SKULLPIC	The hazardous and extremely hazardous pictogram (#4)[1]	E-9.10
LOCKPIC	The keep locked away & out of reach pictogram (#5)[1]	E-9.5
COWPIC	The dangerous/harmful to livestock & poultry pictogram (#6)[1]	E-9.3
EXPIRYPIC	The expiry date pictogram (# 7)[1]	E-9.7
FISHPIC	The dangerous/harmful to fish & water bodies pictogram (#8)[1]	E-9.6
RESPIRATEPIC	The wear respirator pictogram (# 9)[1]	E-9.8
CROSSPIC	The harmful pictogram (#10)[1]	E-9.9

[1] See Table 42 in Chapter Six

Response format: Bivariate (1=correct; 2=incorrect)

TABLE 68: Scatterplot for Assessing a Linear Relationship Between Risk Perception and Risk Communication

N=115 / (r=.30)



middle of Table 68, the higher the correlation. The line direction on Table 68 indicates that the correlation is positive, however, it is a weak correlation as the dots are not clustered around the line.

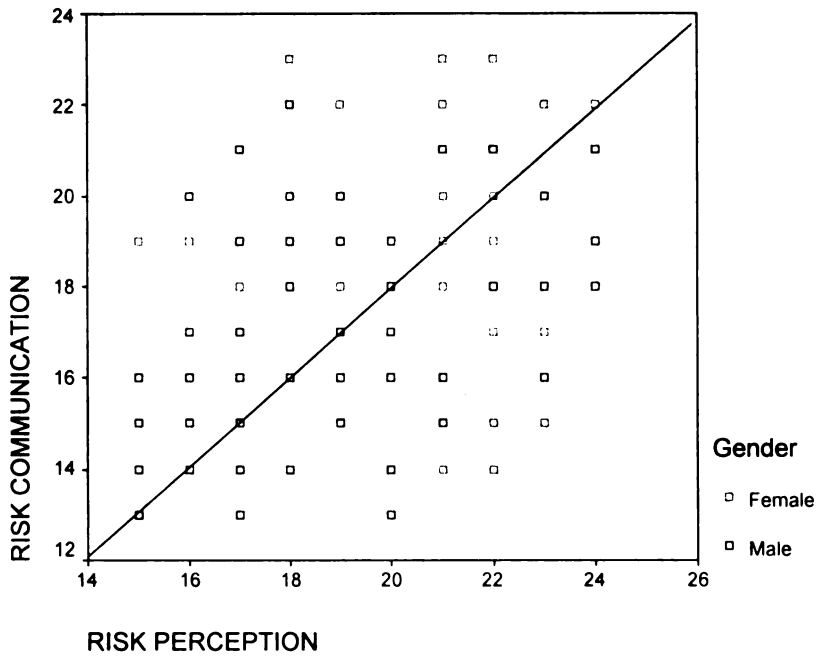
7.2.3. Correlation Test Controlling For Gender

To assess whether there was a relationship between risk perception and risk communication when controlling for gender, I ran a partial correlations test. The resulting partial correlation coefficient was .223, significant at the .018 level. This weak positive, but significant correlation is illustrated as a scatterplot in Table 69. As with the results in Table 68, males and females are scattered around the graph and not clustered close to the line (i.e., indicating a weak correlation). Interesting, Table 69 illustrates that male responses indicate a stronger relationship between risk perception and risk communication than females as their results tend to be closer to the line, where as female responses are generally quite far from the line. Thus the interaction between risk perception and risk communication is weaker for females than males.

7.2.4. Correlation Test Controlling for Occupation

This section assesses, through a partial correlations test, the relationship between risk perception and risk communication when controlling for occupation (i.e., comparing people who work with pesticides with those who do not). The resulting coefficient was .271 and significant at the .004 level. This highly significant, but weak positive correlation, is illustrated in a scatterplot in Table 70. Looking at Table 70, there is not a definitive division of an interaction relationship between those farm workers who work with pesticides and those who do not. In fact I would tend to say that the relationship

TABLE 69: Scatterplot for Assessing a Linear Relationship Between Risk Perception and Risk Communication Controlling for Gender

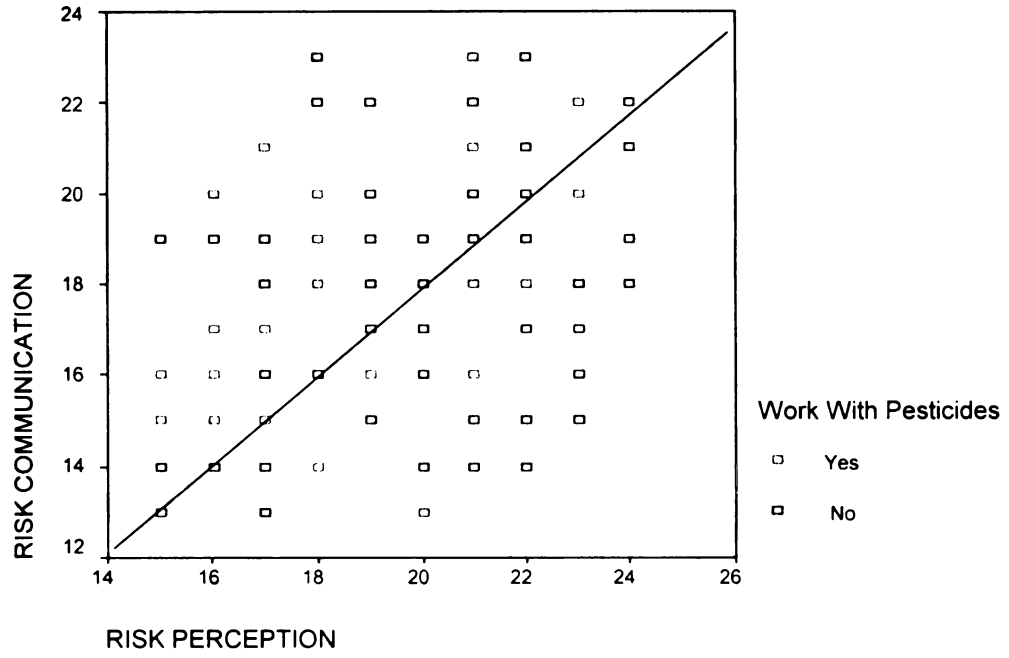


between risk communication and risk perception is more highly correlated for those who do not work with pesticides than for those who do.

7.3. FACTOR ANALYSIS

Now that the tests conducted above have established that an interaction exists between risk perception and risk communication, this section attempts to tease out some essentials of that interaction so as to move beyond the basic level of a connection (outlined in Section 7.2). To achieve this, risk perceptions and risk communication variables are further expanded on in this section through a factor analysis. Factor analysis is an analytic technique to reduce the number of variables being analyzed (i.e., 15 for risk perception and 13 for risk communication) and to detect commonality in the relationships

TABLE 70: Scatterplot for Assessing a Linear Relationship Between Risk Perception and Risk Communication Controlling for Occupation



between variables through classifying and clustering variables into common factors. More specifically, I used the extraction method of Principal Component Analysis which considers the total variance of the variables. At this point I should acknowledge that when I developed the questionnaire, the questions were not specifically structured for plugging the results into a factor analysis as it only became evident later on during the write up that this form of statistical analysis would be appropriate for my research data.[81] However, the factor analysis I conducted gives useful linkage information through explaining why certain variables in my study are correlated and provides the foundation

[81] Although I feel my results are valid in making an interaction association between risk communication and risk perception, I recognize that the variables (i.e., questions) I used to illustrate risk perception and risk communication are not exhaustive and future research may well highlight other valid indicators.

for future research that sets out to use the factor analysis approach with risk perception and risk communication research.

7.3.1. Testing for Sampling Adequacy

Before proceeding with the factor analysis, a Kaiser-Myer-Olkin (KMO) test was run in SPSS to check for sampling adequacy. In order for a satisfactory factor analysis to proceed the KMO, according to the literature, should be greater than .60.[82] Another test of the strength of the relationship amongst the variables is the Bartlett's test of sphericity. This is used to test the null hypothesis that the variables in the correlation matrix are uncorrelated. According to the literature, if Barlett's test is significant then the null hypothesis can be rejected. Thus it is then concluded that the strength of the relationship among the variables is strong and a factor analysis is possible. The KMO for the risk perception variables was .618 and the Barlett's test of sphericity was significant at .000. Thus the risk perception variables are adequate for running a factor analysis. The KMO for the risk communication variables was .642 and the Bartlett's test of sphericity significant at .000. This indicates that the risk communication variables are also adequate for conducting a factor analysis.

7.3.2. Extraction of Initial Factors

After the test of variable adequacy, the next process was to extract the initial factors from my data set. Of the two approaches within factor analysis, I used the "principal component analysis" (PCA) rather than the "common factor analysis" as with the former the total variance (i.e., common and unique) in the data is considered rather

[82] Although some of the factor analysis literature states that the KMO needs to be great than 0.50 to conduct a factor analysis, I choose to stick with the more common index of 0.60 predominately referred to in the literature.

than the common variance. PCA looks for a linear combination of variables with the aim of extracting the maximum variance from the variables in the first instance (i.e., factor 1) and then continues to search for a second (i.e., factor 2), third (i.e., factor 3) and so forth linear combination representing the maximum proportion of the remaining variances for each linear combination. The resulting correlations between the variables and the five new factors for risk perception and risk communication are referred to as "factor loadings" (see Appendix F for these unrotated results). To obtain a pattern of these loadings, that is present factors that clearly represent high loadings for some variables and low loadings for others, a rotational strategy was used. There are several rotational strategies available, but for this analysis I used the *varimax* strategy with SPSS. Tables 71 and 72 are the rotated results of the factor analysis for risk perception and risk communication respectively.

TABLE 71: Risk Perception Variable Factors' Rotated Component Matrix

Variable Name	Component Factors				
	1	2	3	4	5
POISONOUS		.659			
DANGEROUS		.807			
RANKPEST			.575		
PESTSPRAY			.598		
WORKPEST			.615		
CHILDPLAY			.707		
ACUTE		.611			
CHRONIC				.613	
CHILD	.795				
ALLSICK		.616			
HARMSELF					.842
COWORKER	.656				
FETUS	.749				
FERTILITY	.564				
PPEFULL				.817	

Extraction Method: Principal Component Analysis
Rotations Method: Varimax with Kaiser Normalization
Rotation converged in 5 iterations

TABLE 72: Risk Communication Variable Factors' Rotated Component Matrix

Variable Name	Component Factors				
	1	2	3	4	5
CONTAINER	.679				
CORRECTC		-.728			
UTENSILS	.630				
GLOVEPIC	.625				
HANDPIC					.681
BOOTSPIC	.559				
SKULLPIC			.784		
LOCKPIC					.506
COWPIC				.862	
EXPIRYPIC		.765			
FISHPIC		.524			
RESPIRATEPIC			.676		
CROSSPIC					.718

Extraction Method: Principal Component Analysis
Rotations Method: Varimax with Kaiser Normalization
Rotation converged in 7 iterations

7.3.3. Factors Retained for Analysis

One of the most vital decisions in factor analysis is how many factors to retain for further analysis. This is done by extracting consecutive factors that account for less and less variability. There is no definitive means for choosing which factors to retain and several methods exist to aid in this decision (e.g., eigenvalue greater than or equal to one, the scree plot, proportion of factor variance, a chi-square test).[83] However, it is a fairly subjective decision in the end and the researcher needs to retain enough factors to make analytical sense. I relied on the Kaiser criterion to decide which factors to keep. This is the most commonly used method in social science, where the decision is based on whether the eigenvalues are greater than or equal to 1.00 (see Appendix F for the eignevalue tables for risk perception and risk communication). The idea behind using the eigenvalues is that those factors with a value greater than one are more able to explain the

[83] For a good succinct review of each of the five methods available for deciding which factors to retain for analysis, see: http://www.utexas.edu/its/rc/answers/general/gen16.html

common variance shared among the variables. The result of the eigenvalue tests in Appendix F for was that I retained the first five factors for both risk perception and risk communication.

7.3.4. Factor Interpretation

Interpreting substantively and conceptually what each factor means is the most challenging and difficult aspect of factor analysis. This process is highly subjective and requires the researcher to link what the results are saying to theory. In interpreting what each of the factors in risk perception and risk communication could be saying, I tried to hold in mind that the factor analysis literature states that each factor is meant to represent a continuum along which people vary and that factors should not represent separate groups of people.

7.3.4.1. Exploratory Interpretations of Risk Perception Factor 1

Risk perception factor 1 (RPF1) is based on four of the 15 pesticide risk perception items, (1) for which each respondent's answers were similar, and (2) which had the most difference from the other 11 items. These variables were (see Table 71): pesticide effects on a worker's child's health (CHILD), pesticide risks to a co-worker's health (COWORKER), pesticides affect a fetus (FETUS) and pesticides affect fertility (FERTILITY). In trying to conceptualize what substantive content these four factors had in common and what differentiated this factor from the other factors, I created a table with conceptual meanings (see Table 73).

TABLE 73: Conceptual Interpretations of Risk Perception Factors

RP Factor 1	RP Factor 2	RP Factor 3	RP Factor 4	RP Factor 5
- child health - cowork health - affect fetus - affect fertility	- All dangerous - All poisonous - Acute effects - All make sick	- Rank pesticides - Rank spray - Rank work pest - Rank child play	- chronic effects - PPE full protection	- harm self
- perceived risk in relation to others - non-tangible risk - unimaginable risk - self-deceptive risk - risk outside of self higher - external risks higher than internal risks - peripheral risk - remote risk - uncontrollable risk	- perceived severity of pesticides out of context - pesticide attribute risks	- perceived severity of pesticides in context - pesticides viewed as risky in relation to other risks	-behavioral expectation	- perceived susceptibility -tangible risk -internal risk
RPF1 Label	**RPF2 Label**	**RPF3 Label**	**RPF4 Label**	**RPF5 Label**
Externalized risk	**Risk attributes**	**Relative risk**	**Behavioral expectation**	**Tangible risk**

These four variables in RPF1 relate to pesticides affecting "others". In terms of fertility/sterility, this is a complex concept and based on previous research I was involved in[84], many people in South Africa do not associate a problem with being able to conceive as necessarily being a problem with their own body. Thus, fertility and sterility, as may be the case, are perceived to be distant from and not involving the person responding to the question. Therefore, it made sense that respondents would answer the questions for CHILD, COWORKER and FETUS the same as for FERTILITY. That is, the conceptual similarity between these responses is that the health effect of pesticide exposure is occurring to some "other". This could well be because the respondents are viewing

[84] In 1998, I was involved in a study assessing the whether DDT spraymen in Northern South Africa had a lower sperm count than non-spraying men. I was involved in the writing of the questionnaire as well as administering to spraymen and spraymen's wives.

"external risk" to themselves or "peripheral risk" as having a higher risk than in relation to possible health effects to self (which most explicitly is listed as factor 5, see Table 71). In relation to self-efficacy, the respondents see that they can control pesticide effects to self, but not to others. Thus this factor can also be interpreted as being non-tangible risk, unimaginable risk (the unknown creating more fear) and remote risk. I also referred to this factor as "self-deceptive risk" in that the impact on fertility and fetus is assumed to be affecting others and not self. These risks are "non-tangible", that is they cannot be fully understood by the respondent and therefore are more risky. RPF1 has been labeled as the "externalized risk" factor.

7.3.4.2. Exploratory Interpretations of Risk Perception Factor 2

For Risk perception factor 2 (RPF2), DANGEROUS, POISONOUS, ACUTE, and ALLSICK were the four variables clustered together as having similar respondent answers, but different from the other risk perception variables (see Table 71). I have defined this factor as meaning "perceived severity of pesticides" (see Table 73). That is, the variables listed all have to do with belief and attitudes in relation to the generalized pesticide product itself out of context. The belief is based purely on the attributes of a pesticide and not whether it is used by a particular person, with PPE or without, or any other contextual aspect. The belief that pesticides are risky, which is implied by these variables falling into factor two, is not indicative of what is causing this belief. That is, factor two gives no contextual reference. The factor label given to RPF2 is "risk attributes" (see Table 70).

7.3.4.3. Exploratory Interpretations of Risk Perception Factor 3

For risk perception factor 3 (RPF3), all four variables were related to rank questions from the questionnaire (i.e., RANKPEST, PESTSPRAY, WORKPEST, and CHILDPLAY; see Table 71). In some respects, rank questions are considered more contextualized as each one placed the respondent into contextual situations they were socially and culturally familiar with from working with pesticides, and cigarette smoke, to children swimming in dams, drinking local wine, and children playing in a sprayed field (see Table 73). Thus, where RPF1 referred to risk to "others" and RPF2 referred to the risk attributes of the pesticide itself, RPF3 refers to the contextual risk of pesticides in relation to other socially and culturally present risks. That is, this factor sees the risks of pesticides as high in relation to other risks. Thus, RPF3 is labeled as the "relative risk" factor.

7.3.4.4. Exploratory Interpretations of Risk Perception Factor 4

For risk perception factor 4 (RPF4), respondents responded similarly to the variables CHRONIC (i.e., belief that pesticides can cause health effects in the future) and PPEFULL (i.e., that PPE can provide full and complete protection from pesticides' negative health effects; see Table 71)). These two variables provide quite a challenge for interpreting the conceptual rationale behind why study responses cluster these two variables together. My interpretation requires a bit of lateral thinking. That is, I have seen these as implying "behavioral expectations" (see Table 73) in terms of the respondent's behavior in relation to the pesticide risk (e.g., wearing PPE) and the respondent's expectation of the outcomes from their behaviors (e.g., chronic effects from pesticides if PPE is not worn). Thus the RPF4 label is the "behavior expectations" factor.

Perhaps another element to these two variables is that they are both somewhat more sophisticated than the previous risk perception variables. That is, PPE implies that the effects of pesticides are contingent on specific contextual factors and specifically on factors that (to some extent) the respondent can control, and chronic implies that the impacts of pesticides are various and diverse, and much less obvious than those associated with acute poisoning.

7.3.4.5. Exploratory Interpretations of Risk Perception Factor 5

Only one variable fell into this last factor, risk perception factor 5 (RPF5). This is the HARMSELF variable where the belief is that pesticides can affect an individual's health (see Table 71). As previously stated, by this variable falling in factor five it implies that effects to self are seen as different in relation to pesticide effects to others (e.g., RPF1). This factor is conceptualized as implying a perceived susceptibility to pesticide risks for self and that the risks are tangible (see Table 73). What is implied is that by the risks to self being understood by the respondent, the respondent does not view the risks as high because the respondent is in control of the risks to self. The label for RPF5 is "tangible risk".

7.3.4.6. Exploratory Interpretations of Risk Communication Factor 1

Now moving on to the interpretations of the five risk communication factors we start with the interpretations for risk communication factor 1 (RCF1; see Table 72). Four variables share the same conceptual construct, namely CONTAINER, UTENSILS, BOOTSPIC and GLOVESPIC, i.e., two pesticide label precautionary text variables and two commonly understood pictograms (see Table 72). My interpretation of this factor is

that respondents responding the same to these four variables subscribe (or do not subscribe) to the technological rationality of pesticide labels and that this factor can be strongly related to literacy and reading skills. This is because most people are instructed to burn pesticide containers and the findings in Chapter Six indicated that even some managers were not aware that not all pesticide containers can be burnt. Thus, in order to have correctly responded to this question a respondent most likely would have read and understood the label. None of the other 13 factors required the ability to read and understand what was written on the label. How do the UTENSILS, BOOTS and GLOVES variables fit in with predictors of high literacy and reading skills that the other variables do not? Again, a bit of lateral thinking is required. Eating utensils translated into Afrikaans was a technical word not used colloquially, thus the respondents would have had to have a certain level of knowledge and literacy to figure out what this meant. By reading the label for the container question and understanding of the Afrikaans word for "eating utensils" there is some subscription to a technological rational way of thinking. The boots and gloves pictogram could be, in theory, very easily interpreted if one subscribed to a technological rational way of thinking and applied the knowledge to working with pesticides. Looking at these four variables in terms of the sociology of knowledge and linguistically, as well as borrowing from an anthropological debate, I labeled RCF1 as the "etic" factor (see Table 74). This is because I find the *etic* perspective aptly expresses the technological rationality behind the definitions of these four variables. This perspective (Headland et al. 1990) relies on conceptual schemes and categories which are viewed as meaningful and appropriate by biogeophysical scientists (e.g., the use of a picture of boots to mean "wear boots"), that is the "outsider".

TABLE 74: Interpretations of Risk Communication Factors

RC Factor 1	RC Factor 2	RC Factor 3	RC Factor 4	RC Factor 5
- container - utensils - boots - gloves	- fish - expiry - color codes	- skull - respirator	- cow	- hands - lock - cross
- predicts high literacy and reading skills - high awareness of pesticide label - correct deduction skills - not influenced by authority - doesn't make associations - previous exposure to technological rational interpretations - subscribe to technological rationality - technological rationality framing	- previous exposure/training - personal context and circumstances	- familiarity by respondent - frequency of visibility - familiarity with pictogram - inference	- owns cattle - economic vested interest - familiarity with subject matter - social contextual relevance (or framing)	- influences safety of self and others - previously used and seen in work context - commonly used pictograms found on all pesticide labels - frequency of use on labels - work and home context exposure - frequency of exposure to
RCF1 Label	**RCF2 Label**	**RCF3 Label**	**RCF4 Label**	**RCF5 Label**
Etic View	**Previous training/exposure**	**Familiarity**	**Emic view**	**Frequency of use**

7.3.4.7. Exploratory Interpretations of Risk Communication Factor 2

Risk communication factor 2 (RCF2) has the variables FISHPIC, EXPIRYPIC and CORRECTC associated with it (see Table 72). The two pictograms and the color codes for toxicity are very complex items to interpret. Thus, in trying to understand the underlying concept that these three shared it became evident that this variable should be a predictor of previous training[85] or previous exposure to what these variables are

[85] The Pearson correlation between the ever received training variable and RCF2was r=.237 significant at the .01 level. This implies that there could be a predictor relationship between the two.

technologically intended to mean (see Table 74). More so than other pictograms and communication vehicles used on the pesticide label, these three are quite abstract culturally and would need some previous insight or exposure to interpreting these correctly. Thus RCF2 is labeled as the "previous training/exposure" factor.

7.3.4.8. Exploratory Interpretations of Risk Communication Factor 3

Risk communication factor 3 (RCF3) has two variables, SKULLPIC and RESPIRATORPIC (see Table 72). This factor is seen as due to "familiarity" with risk communication tools and specifically pictograms (see Table 74). The skull and cross bones is a commonly used pictogram found on warning signs throughout South Africa. How does the respirator pictogram relate? Well, first one needs to recall from Chapter Six that the respirator pictogram is predominately perceived to mean "mask". Masks are commonly worn throughout South Africa by many workmen, not only pesticide applicators, and are available in shops for users of paints and solvents, etc. Thus these two pictograms indicate familiarity not necessarily in relation to only being found on pesticide labels, but familiarity with what the pictures represent. RCF3 is therefore labeled the "familiarity" factor.

7.3.4.9. Exploratory Interpretations of Risk Communication Factor 4

Risk communication factor 4 (RCF4) had only one variable clustered under it; the COWPIC variable (see Table 72). In thinking why this response would be different from the other four risk communication factors it became clear that this factor is indicates a "familiarity with subject matter" of the question (see Table 74) and contextual framing influence. That is, culturally respondents are familiar with livestock and poultry kept by

themselves or neighbors. Thus the responses to this question indicated that many respondents were making an association with their immediate social and cultural context. There is also possibly an implication that this factor could be an indicator that the respondent has a vested interest (e.g., economic) in the subject matter of the question. However, this would need to be further tested and is only being suggested here. Borrowing again from anthropology, I have labeled RCF4 as the "emic" factor. Emic perspectives refer to conceptual schemes and groupings that are meaningful to members of a particular cultural group. That is an emic construct (e.g., interpretation of the cow pictogram) is in accord with the perceptions and understandings believed to be appropriate by the "insiders" culture (Headland et al. 1990).

7.3.4.10. Exploratory Interpretations of Risk Communication Factor 5

Risk communication factor 5 (RCF5) had the following three variables associated with it: HANDPIC, LOCKPIC, and CROSSPIC (see Table 72). All three of these pictograms, in comparison to all the pictograms available for use on pesticide labels, are the most commonly used and found on most agricultural and domestic pesticide labels. Thus I have classified this factor as a predictor of "frequency of exposure" and "frequency of use" (see Table 74). The skull and cross bones pictogram is not used on domestic labels, however, the cross is. RCF5 is labeled as the "frequency of use" factor. However, frequency of use does not necessarily imply effect on comprehension, just that these similar pictograms were clustered together, respondents answer questions on these the same and that they are different from the other four factors.

7.4. CORRELATIONS BETWEEN RISK PERCEPTION AND RISK COMMUNICATION FACTORS

In order to analyze the correlations between the five retained risk perception and five risk communication factors, factor scores were calculated through SPSS for each factor for each respondent. Table 75, the resultant correlation results, illustrates that there is a significant relationship between 1) RPF1 and RCF3; 2) RPF2 and RCF1; 3) RPF3 and RCF1; 4) RPF3 and RCF4; and 5) RPF5 and RCF4. What these factor relationships are indicating in terms of the interaction between risk perception and risk communication will be discussed. Although there are other correlations in Table 75 that are nearly significant, these are not discussed. At this stage of analyzing the interaction

TABLE 75: Correlation Matrix for Risk Communication and Risk Perception Factors

(N=115)

	RCF1 *Etic View*	**RCF2** *Previous training/exposure*	**RCF3** *Familiarity*	**RCF4** *Emic view*	**RCF5** *Frequency of use*
RPF1 *Externalized Risk*	r p	r p	r p	r p	r p
	.054 .568	.159 .089	.313** .001	.169 .072	.124 .185
RPF2 *Risk Attributes*	-.343** .000	.014 .879	.073 .439	.109 .245	-.076 .423
RPF3 *Relative Risk*	.200* .032	.098 .297	.041 .663	.264** .004	.101 .281
RPF4 *Behavioral Expectation*	.076 .420	.042 .656	.156 .096	-.068 .471	-.019 .842
RPF5 *Tangible risk*	.073 .436	-.007 .943	.012 .900	.178 .057	.019 .841

RCF=risk communication factor; RPF=risk perception factor

** Correlation is significant at the .01 level;* Correlation is significant at the .05 level

r=Pearson Correlation; p= significance (2-tailed)

between risk perception and risk communication, only the significant correlations are discussed.

7.4.1. Understanding the Interaction Between RPF1 and RCF3

These two factors, RPF1 and RCF3, have a significant correlation at the .001 level (see Table 75). What is of interest is the interaction between this risk perception factor labeled as "externalized risk" and this risk communication factor labeled as "familiarity". The positive correlation between these two factors indicates that a "yes" belief in relation to the variables in RPF1 is associated with a "correct" understanding of the variables in RCF3 and visa versa. What the correlation between these two factors appears to say about the interaction between the two is that when respondents are familiar with a risk communication strategy (i.e., respirator and skull-and-crossbones pictograms on the pesticide label) then their perception of a high risk being evident for others exposed to the hazard (e.g., pesticides effect the health of a worker's child or the health of a co-worker or a fetus) is high. Inversely, when a respondent does not have a high perception of a risk to others exposed to a hazard or risk, then their familiarity of these risk communication components is low.

The question is why does the risk perception factor of externalized risk positively correlate with the risk communication factor of familiarity? A hypothesized reason is that a person who is self-deceptive and externalizes risk (specifically pesticide risks in this case) has a level of awareness in regard to potential risks that may be communicated about the hazard in question (e.g., familiar with the skull and cross bones and respirator pictogram). This correlation could also, inversely, imply by understanding that pesticides are very toxic as the use of a respirator is required and understanding that pesticides are

extremely poisonous because of a skull-and-crossbones is on the label, this could lead a person to believe in the externalized risks of pesticide health effects resulting to children, co-workers, a fetus and causing fertility problems.

7.4.2. Understanding the Interaction Between RPF2 and RCF1

RPF2 is labeled as the "risk attributes" risk perception factor, while RCF1 is labeled as the "etic view" risk communication factor. The correlation between these two factors is a negatively significant correlation at the .000 level (see Table 75). This correlation seems to imply that when a respondent has a "no" belief in the attributes associated with a risk (i.e., do not believe that all pesticides are dangerous or all pesticides are poisonous or that all pesticides can make you sick or that all pesticides can make you sick straight away), then they are inclined to have "correct" interpretations of the technological rational risk communication components (i.e., correctly interpret what eating utensils mean or correctly interpret the wear boots pictogram). Of interest is that the etic view is negatively correlated with risk attributes. The hypothesis here is that a propensity to understand technological rational meanings on risk communication tools potentially suppresses the belief that the particular risk/hazard in question is dangerous.

In attempting to understand this negative correlation and hypothesis, which appears counterintuitive, there is a need to reflect back upon the findings in Chapter Five where workers who had received pesticide training had a lower risk perception for some beliefs and farm workers with a higher level of education had lower pesticide risk perceptions. An assumption was that a latent function of safe-use training is to convince farm workers that pesticides are intrinsically safe. In terms of education, a latent function of the formal educational system is to convince individuals that technological

innovations, such as pesticides, are favorable and positive for crop production, alleviating poverty and promoting sustainable development. Perhaps it is these latent functions which are affecting this negative correlation between RPF2 and RCF1. Inversely, if a person believes that risk attributes of a hazard causes effects, these beliefs are then associated with an incorrect understanding of the risk information being communicated.

7.4.3. Understanding the Interaction Between RPF3 and RCF1

RPF3 is labeled as the "relative risk" risk perception factor and RCF1 is labeled as the "etic view" risk communication factor. The positive correlation between these two factors is significant at the .05 level (see Table 75). The risk perception factor of relative risk (i.e., ranking pesticides as dangerous in relation to other socially/culturally present risks) is seen to positively interact with the etic view of risk communication (i.e., in that pesticides risks are determined by "outsiders" to a cultural and social context where this technology is used). In this study, this means that a person who correctly defined what the wear boots and gloves pictograms were and read the label that a pesticide container could not be burnt were more inclined to rank pesticides as more dangerous in relation to other hazards, as well as spraying pesticides in relation to drinking or smoking.

Why is it that the etic view of risk communication is positively correlated with the relative risk belief in risk perception? It is hypothesized (based on the manifest content of this relationship) that if a person subscribes to the technological rationality (i.e., scientific findings) about risks associated with a risk being communicated, then they are more inclined to believe that the risks associated are higher in relation to other risks they are exposed to.

7.4.4. Understanding the Interaction Between RPF3 and RCF4

These two factors, labeled as "relative risk" (RPF3) and "emic risk" (RCF4) are significantly and positively correlated at the .01 level (see Table 75). Interesting is the connection both these factors have with the cultural and social context within which the risk is taking place. For example, that the correct interpretation of the livestock and poultry pictogram is positively correlated with the perception that pesticide risks rank higher in relation to other risks. The interaction between these two factors highlights that risk perception and risk communication are linked by the cultural and social context within which the risk exists. Of further interest is that the risk perception factor of relative risk is correlated with both the etic and emic view of risk communication.

It is hypothesized that a person who ranks, for example, pesticide risks as high in relation to other risks they are exposed to, are inclined to correctly understand that harm in relation to a person, place or thing they may have a vested (particularly economic) interest in (e.g., the pictograms stating that pesticides are dangerous/harmful to cattle and poultry).

7.4.5. Understanding the Interaction Between RPF5 and RCF4

The positive correlation between these two factors is nearly significant at the .05 level (see Table 75). RPF5 is labeled as the "tangible risk" risk perception factor and RPC4 is labeled as the "emic view" risk communication factor. This interaction tends to make sense. That is, if a person thinks a pesticide is harmful to their health (i.e., a tangible risk), then they will also correctly interpret the pesticide label pictogram that a particular pesticide is harmful/dangerous to (most likely their) cattle and poultry (i.e., emic view). A hypothesized reasoning for this is that a high risk to self is associated with

a high risk to what a person has a vested interest in (particularly if it is of economic significance).

7.4.6. Summary of Interaction Correlated Findings

The correlation analysis between the risk perception and risk communication factors emanating from the research findings in this dissertation highlight that an interaction between these does exist. Of particular interest are the resulting factors from the factor analysis which appear to be significant for further investigation (see Table 76). For risk perception, these are the factors of externalized risk, risk attributes and relative risk. For risk communication, these factors are the etic view, familiarity and the emic view. What these factors imply is that the interaction between the two fields is occurring at the level of a person externalizing risks of a hazards, believing in the risk characteristics and finding the risk contextually relative, then the person is more familiar with risk communication tools understanding these both in terms of their social context and the technological meanings intended. What is particularly interesting to further investigate is that both the etic and emic view of risk communication are significantly correlated with the risk perception relative risk factor. That is, what are the circumstances that lead to an etic view and relative risk relationship in relation to a emic view and relative risk relationship?

TABLE 76: Significantly Correlated Risk Perception and Risk Communication Factors

RCF	RPF
Familiarity	Externalized risk
Etic view	Risk attributes
Etic.view	Relative risk
Emic view	Relative risk
Emic view	Tangible risk

Negatively correlated

7.5 CONCLUSION

This third findings chapter has brought together the findings from Chapter Five on risk perception and Chapter Six on risk communication to illustrate that an interaction does occur between variables representing each. As this was exploratory research to assess whether an interaction exists and whether researchers should be concentrating more on this interaction, the findings are not conclusive, but set the stage for further inquiry.

There were some advantages and disadvantages to employing a factor analysis approach for assessing if an interaction exists between risk perception and risk communication. The advantages of the method were that both technological rational (i.e., "objective") and cultural rational (i.e., "subjective") attributes of the pesticide label and pesticide risk beliefs could be used. The actual testing procedure was fairly easy to conduct (except for the interpretation part). Also, the flexibility in defining the factors conceptual meaning was an advantage for qualitative research. The disadvantage of factor analysis is the interpreting and labeling the factors is so subjective and difficult.

The interaction between risk communication and risk perception further highlights the shared context between the two within which the risk is taking place (e.g., pesticide use), the social actor (e.g., farm workers), the cultural context (e.g., lack of a pesticide label culture, coupled with a culture of pesticide use), the political context (e.g., good regulatory structure, limited enforcement, lack of political support for pesticide issues), the economic context (e.g., job security precarious) and the historical context (e.g., Apartheid supremacy and subordination). That is, as risk is a social construction,

both pesticide risk perceptions and the use and understanding of pesticide label as a risk communication tool are also socially constructed.

CHAPTER EIGHT

CONCLUSION

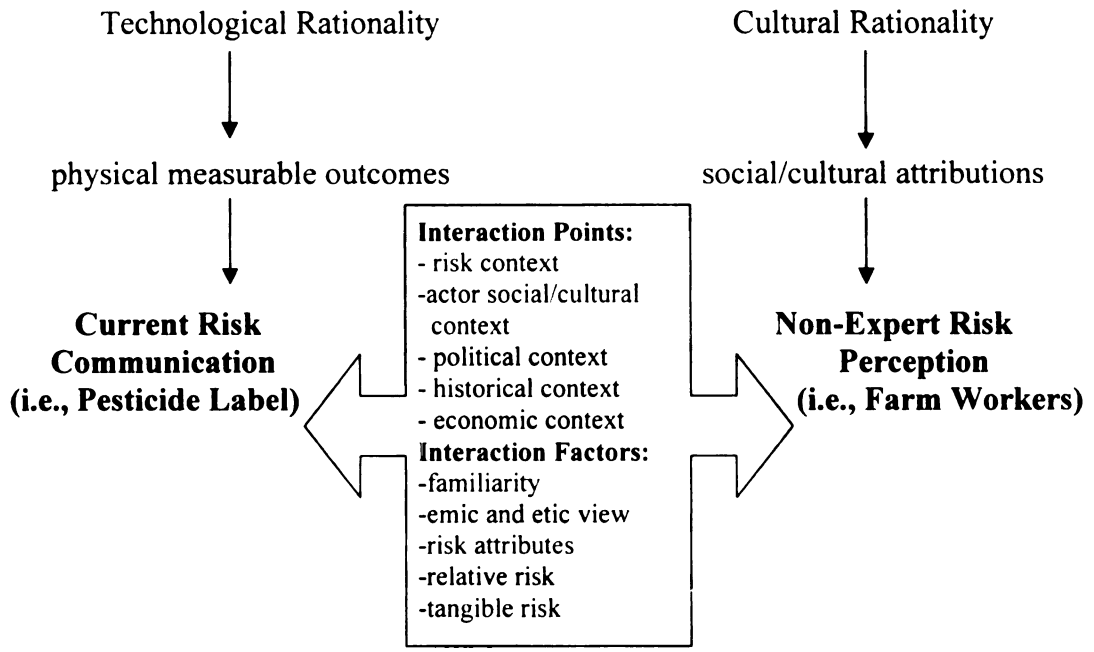
8.1 RESEARCH CONTRIBUTIONS

This dissertation focused on the sociological analysis of risk and more specifically, on farm workers pesticide risk beliefs, as well as the pesticide label as risk communication for pesticide risk management. Risk, the pivotal focus of this dissertation, was argued to not solely be socially constructed (Dake 1992), but instead to consist of a dual nature (Klinke and Renn 2002) reflecting technological rationality expressed through risk communication and cultural rationality expressed through risk perceptions. In concluding this dissertation, I would like to reflect on Chapter One where the reader was presented with Figure One and the hypothesis that an interaction between risk communication and risk perception affects the social actor's behavior when confronted with risk. In doing so, this final chapter presents some of the research contributions and suggestions for future research emanating from this study that illuminate this interaction. The research contributions are theoretical, have policy implications and are applicable to other relevant issues.

This dissertation began with a presentation of Figure 2 in Chapter One minus the interaction; after presenting the three chapters of research findings, some interaction points and factors identified in this study have been added (see Figure 18). A finite list of interaction points and factors does not exist, but changes continually, especially based on the contextual nature of the risk communication tool and the target groups' perceptions.

The key is that risk perception and risk communication are interacting in a contextual arena which forms the basis of the social construction of each (see Figure 18).

Figure 18: The Dual Nature of Risk - Risk Communication and Risk Perception Interaction



8.1.1. Theoretical Significance - Risk Perceptions

The findings from this study indicate that conducting risk perception research in developing countries is complex. Despite this complexity, this dissertation has made a needed contribution to analyzing risk perception outside of a developed country context and specially, by contributing insights from a target group base that are not university students or formally educated consumers. The contribution of this dissertation is not so much new theoretical constructs and methodological approaches, as providing data on various aspects of conducting risk perceptions research, particularly from a developing country context. One such contribution from this research is that the issue of using the

term "risk" for conducting research and comparing research findings with other studies. In this study, the actual term for risk was not colloquially used amongst farm workers (see Chapter Four focus group discussion). Furthermore, terminological interplay exists in Afrikaans with the terms used to express pesticide risks, such as poisonous, dangerous and hazardous. Consequently, assessing risk perceptions based on the English concept of "risk" is problematic and perhaps a bit meaningless when conducting comparative research. In this study, risk was defined in terms of what that actual risk implication is (i.e., dangerous or poisonous), which worked. By again emphasizing the social construction of risk, risk perception researchers need to broaden the base of using the word "risk" and assess what are the implications of doing this.

Another research contribution was from the resulting data and analysis of South African farm workers' pesticide risk perceptions. The dissertation began by inquiring 1) What are farm workers' pesticide risk perceptions? 2) What are the social contexts within which these perceptions are formed and the processes affecting their formation? 3) What are South African farm workers' perceptions of the relationship(s) between pesticides and their own and others' health? The rich analysis presented in Chapter Five illustrated that although there is not a culture of perceiving pesticide risks, once probed, farm workers in general had a high pesticide risk perception for self, but generally perceived others (e.g., co-workers, children, fetus) to be more at risk than themselves. A caveat to workers' generally high perception of risks associated with pesticides (discussed in Chapter Five) is that these farm workers' perceptions were contextualized and were influenced by not only their social/cultural context but also the historical legacy

of Apartheid and the existence of a subservient relationship between farm workers and farm owners.

Perhaps one of the more significant outcomes of this dissertation is just how much farm workers' risk perceptions were influenced by a range of factors. One finding is the influence of gender on perception. In general, the risk perception and gender literature is sparse, focusing mainly on gender differences in developed countries. These gender variations found in developed countries tend to focus on gender differences in terms of concern about technological hazards. However, this research highlighted, what may be of greater importance for risk perception research, is the gendered perception of "who" is more at risk from exposure to a particular technological hazard (pesticides in this case). This dissertation research illuminated how men and women both believed that women were not exposed to pesticides because they predominately do not spray pesticides and that working in sprayed fields and preparing pesticide solutions for spraying are not seen as being "exposed" to pesticides. Risk perception researchers thus may well need to alter their own perceptions on how to research gender and risk perceptions.

Another relevant factor identified in this research was that "authority influences" affected farm workers' perceptions (e.g., that pesticides make you sick) and decisions about perceptions (e.g., know this because the farm manager tells us). This challenges traditional psychometric and value expectancy models of risk perception research where risk perceptions are assessed based on the individual's response to risk (e.g., "fright factors", "perceived severity"). I am not convinced that "cultural biases" (i.e., shared values and beliefs; see Chapter Three) from Cultural Theory would capture this "power" influence as again the focus is on an individual's view of risk through identifying with a

cultural group interpretation of risk. However, "authority influences" identified in this research bring to light the need to further evaluate power relation influences on individual's perceptions of risk.

8.1.2. Theoretical Significance - Risk Communication

What was clear from this dissertation is that risk communication in developed countries, and specifically in the United States, plays a specific (often legislated) role in risk management both on the part of government and industry and that this role is limited in developing countries such as South Africa. The present risk communication literature does not reflect or highlight this variation in the role of risk communication in different country and political contexts. Thus this research has provided a sociological contribution to broadening the understanding of risk communication issues in a developing country by providing a detailed analysis of the problems with South African farm workers using the pesticide label as a risk communication tool. The particular contributing sociological insights stem from the rich findings in Chapter Six on how farm workers interpreted the various technological rational components of the pesticide labels, as well as what influenced these interpretations (e.g., authority influences, gender, occupation).

As with risk perceptions, this research highlighted the authority influences on risk communication interpretation. A reoccurring theme in this dissertation is that since farm workers have limited awareness of the existence of the pesticide label as a risk communication tool, their interpretation of the label component meanings is influenced by contextual factors (e.g., their work, the farmer/farm manager, other workers) and thus varies greatly between respondents. For example, farm workers' are not encouraged or

taught by authority figures to read the label, other than predominately for use and measurement instructions, and are therefore generally not aware of the hazard and first aid information on the label. The present risk communication literature reviews risk communication "objectively" from a technological rational perspective. What this research adds to the literature is that risk communication is "subjective" and contextually influenced. Thus the literature would do well to provide more sociological insights, such as those from this research, on authority influences on risk communication and its effectiveness.

8.1.3. Theoretical Significance - Interaction

Another significant contribution from this dissertation research is (1) the argument that risk perception and risk communication should not be studied in isolation of one another or for the purpose of altering lay risk beliefs through risk communication strategies, (2) the identification that an interaction exists between the two fields, and (3) opening up a debate that does not presently exist in the risk perception and risk communication research. This research provides data that moves beyond looking a risk perception factors as merely indicators of the risk itself, but identified factors that illustrated the perceivers' perspective on risk and how this interacts with a risk communication tool such as the pesticide label.

8.1.4. Policy Implications of Research Findings

This research challenges the viability of the present mechanisms used in regulating and managing pesticide risks in South Africa, as well as in other countries. Risk management policies and strategies need to be structured to incorporate varying

cultural and social contexts, as well as risk perceptions. This research also confronts present policy processes —whether they are authoritarian or whether they involve input from stakeholders – as they do not appear to incorporate vital issues highlighted in this research such as formal literacy, visual literacy and misinterpretations of risk information. Farm workers and the general population are exposed to hazardous pesticides with limited understanding and awareness of the short and long term health implications of these exposures. Pesticide risk management in South Africa puts the onus of responsibility largely on the end user through the legally binding pesticide label. This research highlights the need for South African pesticide policy to shift from managing pesticides to managing pesticide risks contextually (e.g., providing risk communication tools that are "appropriate" for protecting farm workers, especially women).

Risk communication strategies (e.g., the pesticide label) are meant to "inform" end users and others about technological hazards, as well as evoke safety behaviors. In this dissertation is has been argued that these strategies are not objectively developed nor transmitted to objective receivers. Furthermore, the hazard information communicated is interpreted and comprehended differently from person to person depending on the influence of various factors and influences outlined in this research. Pesticide labels, as they are currently designed, are not a viable tool for protecting human health from the exposures of pesticides. Therefore, government policy should initiate a process for developing contextually appropriate pesticide risk communication tools in South Africa rather than importing these from developed countries.

Training appears to play a role in the effective use of the pesticide label as a risk communication tool. Thus policy needs to address the quality control issue of pesticide

training initiatives in South Africa, and other countries, so that pesticide training programs reflect more than the industry's perspective on pesticides (see safe-use training in Chapter Two).

The premise of using risk communication strategies for "equipping" the laity to make "informed" risk decisions raises ethical and human rights issues. If the laity are not comprehending the information as technologically intended because of external factors (e.g., illiteracy, color blindness, inability to interpret technical jargon, unaware of provision of risk information), how are they to make an "informed" risk decision? The mere provision of risk information and assuming that safety behaviors will be evoked when the laity are knowingly exposed to hazardous risks raises serious ethical and moral issues. This research illustrates how the risk communication process is more complex than perceived by industry and government, and that these agencies need to take more ethical and moral responsibility for the risk communication process.

The use of the pesticide label as a risk communication strategy in South Africa reflects the physical properties of pesticides (technical rationality), but does not incorporate or reflect the social/cultural values and norms (cultural rationality) of the target groups using these (e.g., farm workers), limiting their effectiveness. This is a particularly important issue for the on-going United Nations process to globally harmonize hazard communication tools.[86] The research findings from this study emphasize that no hazard communication strategy is intuitively obvious and that risk communication strategies can neither exist nor be interpreted within a social or cultural void. The policy question stimulated from this research then is whether hazard/risk

[86] The Globally Harmonised System of Classification and Labelling of Chemicals (GHS) under the auspices of the United Nations Inter-Organisation Programme for the Safe Management of Chemicals (IOMC).

communication tools can be globally harmonized while still attempting to safe guard human health and the environment? Or does this process only further entrench industry's handing on liability to the end user through a system meant to reduce costs for industry and result in broader distribution of chemicals as the labeling systems will be the same for all countries?

8.1.5. Applicability Of Research To Other Issues

The analysis of the pesticide label and its effectiveness as a means to communicate risks to lay persons can be extended to the labeling of many products such as, Genetically Modified Organisms (GMO's), organic products, other chemicals such as paint, cosmetics, pool chemicals and so forth, as well as the labeling of medications and nutrition labels and health claims. Labeling of products makes assumptions about the target audience's comprehension abilities, social context and ability to execute this information. The findings of this research (e.g., that the components of pesticide labels are misinterpreted and misunderstood) is applicable to labeling in general and highlights the need for globally analyzing and challenging the use of labels as risk communication tools for the laity.

Pictograms continue to be used on signage and labels globally with the notion of bypassing literacy and proclaiming simplicity. As mentioned, the United Nations initiative for developing a globally harmonized system for classification and labeling of hazardous chemicals is attempting to narrow down the use of symbols for hazardous chemicals to a universal few. For example, many countries will soon be implementing the GHS which will introduce new pictograms depicting health hazards. One of the controversial pictograms is the chronic health hazards symbol, (a half human figure with



a large white and black star on the chest). Based on the findings of this study that interpretation of pictograms is based on social cultural influences, the interpretations of this chronic symbol could lend to multiple misinterpretations, if not critical confusions (e.g., take this chemical to receive super powers). The introduction of this chronic symbol highlights the fundamental problem with industry's technological rationality (i.e., inherent logic) of assuming that individual's health and safety can be protected through the development and use of risk communication tools such as pictograms. It also takes the unrealistic expectation of risk communication tools, such as pictograms, to the extreme. That is, the assumption that a pictogram can reduce chronic exposure to a pesticide regardless of context and measures to reduce exposure (i.e., not using the pesticide at all that has the chronic symbol on it).

Presently in the United States there is a movement in the public health arena to improve on the general population's health literacy. That is, the ability to comprehend health messages, especially from medical practioners (e.g., "I am going to draw some blood", i.e., take blood not paint a picture of it). This research is applicable to the health literacy movement and provides insight into the need for drawing more attention to how the lay interpret information from their social and cultural frames of reference, rather than trying to change their understanding from an asocial or acultural perspective.

Generally, the research findings are applicable to many situations that require lay interpretations of a risk situation (e.g., terrorism, natural disaster, accident) and when these risks are communicated. The same issues arise. Will the information be

understood? How will this information be understood? How does the information influence perceptions? How do risk perceptions influence the risk communication? What affect do these interactions have on risk perceptions, comprehension and ultimately, safety behavior?

8.2. RECOMMENDATIONS FOR FUTURE RESEARCH

This section briefly presents future research initiatives that would benefit generally the field of environmental sociology, but specifically the fields of risk perception, risk communication and the new field (born out of this research) of risk perception/risk communication interaction.

8.2.1. Risk Perception Research

Risk perception research suggestions fall into two categories: (1) methodological and theoretical issues for risk perception research in general, and (2) specific concerns for risk perception research on pesticides. This are briefly listed in point form.

8.2.1.1. Methodological and Theoretical Issues for Future Risk Perception Research

- More research needs to be conducted with a diverse range of target groups, especially in developing countries.
- Research should be conducted on developing non-Western methods for assessing risk.
- Further test the use of social trust as a unit of analysis for risk perception and risk communication research in developing countries. For example, assess trust of the pesticide industry and pesticide label information by various social actors (e.g., farm workers versus non-farm workers) in comparison to one another.
- To date, risk perception research has generally concentrated on adult populations. Children's risk perceptions are undocumented and probably not viewed as relevant for policy issues. For example, children are an evident

component in agricultural production in developing countries and more specifically, many children use and purchase pesticides in South Africa, as well as other developing countries. Children could well be a vehicle in risk communication for reducing pesticide exposure and encouraging safety behavior both for adults and other children. Therefore, research into children's pesticide risk perceptions and comprehension of the pesticide label would be beneficial.

8.2.1.2. Suggestions for Future Risk Perception Research On Pesticides

- This research concentrated mostly on individual risk perceptions by focusing on farm workers in South Africa. However, there would be value in evaluating pesticide risks with other social groups in comparison to one another. For example, whether farm residents versus non-farm resident or consumers have different pesticide risk perceptions from one another and whether these differences are reflected in the pesticide label. That is, are risk communication strategies (i.e., the pesticide label) able to provide risk information appropriate for the differing social and cultural groups within one society.
- As farm ownership was not a variable in the questionnaire, the question remains whether farm ownership increases or reduces perception of risk and should be incorporated into future pesticide risk perception research.
- As stated in Chapter Five, future research is needed to assess what farm workers perceive as acute and chronic health effects, what pesticides farm workers think cause acute and chronic health effects, and why acute effects are not seen as severe as chronic effects, in order to understand how these perceptions influence appropriate safety behavior.
- Future ethnographic research on pesticide perceptions should assess individual's cultural biases of insects and whether, in South Africa (globally?), there is a tendency to view pests as "dirty" and thus pesticides as having "cleansing" properties. Such perceptions influence both the way in which pesticides are used and precautionary measures are taken.
- Further research should assess whether risks (such as pesticides) become scapegoats for other risks (e.g., AIDS) as a form of denial or misunderstanding.

8.2.2. Risk Communication Research

Although this research challenged the viability of pesticide labels as an appropriate risk communication tool for farm worker populations, it was beyond the scope of this study to assess and propose what types of risk communication strategies

would be appropriate. Thus this research is a spring board for stimulating future research needed on participatory risk communication strategies and developing/testing other appropriate cross cultural risk communication strategies. Research on pesticide risk communication strategies (e.g., participatory risk communication) relevant for developing country contexts with rural and illiterate populations can pave the way to reducing ambiguity and uncertainty that presently exists in pesticide risk management.

Another research suggestion is assessing how to include gender and cultural specific issues into risk communication tools, such as the pesticide label. Thus gender and cultural issues should be identified and risk communication tools should be evaluated/tested for gender viability and cultural applicability.

The risk perception literature makes little reference to the role access to information and misinformation has on shaping individual's worldviews and resulting risk perceptions. The risk perception and risk communication literatures assume communicator's acting in good faith are communicating the "best" and "correct" information. However, social scientists need to challenge risk information through more research and analysis of the actual text and meaning of the messages being communicated. Whose responsibility is it to evaluate and test the risk information being communicated?

Future research should evaluate, compare and contrast cultural symbols from varying countries used to highlight toxicity and drawing attention. Perhaps this suggestion brings one to a more sophisticated technological rationality. That, is rather than assuming that some symbols are universal, government and industry should invest in

sociological and/or anthropological research to understand how each society symbolizes different concepts.

8.2.3. Interaction Research

Quite aptly for closing this dissertation is the suggestion that future research focus on the interaction between risk perceptions and risk communications by linking these two in various research endeavors. This dissertation only scratched the surface of analyzing this interaction so as to establish that an interaction exists by identifying some of the factors where the interaction is occurring. Future research could well search for common causes of interaction factors through structural equation modeling, along with teasing out what other factors are associated with risks other than pesticides.

APPENDICES

APPENDIX A

FARM WORKER PESTICIDE LABEL QUESTIONNAIRE
Western Cape Province 2003

Respondent Number: ☐☐☐ **Date:** ☐☐☐

Interviewer's initials: _____

Farming Sector: ☐ **Fruit** ☐ **Wine** ☐ **Other**_____

Area where farm is located: _____

Consent: The consent form was read by or to the respondent, they understand that participation is voluntary and they have agreed to participate in this study. **Tick** ☐

A. General Background

A –1. Gender: **Female** ☐ **Male** ☐

A- 2. Age/DOB: _____

A-3. Level of Education: (tick one – highest level achieved)

1) No formal education at all ☐
2) did not complete primary school ☐
3) completed primary school ☐
4) did not complete secondary school ☐
5) Completed secondary school ☐
6) Did not complete tertiary education ☐
7) Tertiary education: ☐
8) Other (specify)_____ ☐

_____

A-4. Literacy

	NO	A little	Very Well (fluent)
1) Can you speak Afrikaans?			
2) Can you read Afrikaans?			
3) Can you write Afrikaans?			
4) Can you speak English?			
5) Can you read English?			
6) Can you write English?			

A-5. Occupation/Job title

A-5.1: What job are you currently doing?

Tick answer(s)	YES	NO
1. Sprayman (includes spraying, mixing, sprayer driver)		
2. Foreman or supervisor		
3. General farm worker		
4. Tractor driver or driver		
5. Other (specify)		

A-5.2: How long have you worked in this position on this farm job?

_____ Years (or the year in which started working)
_____ Months

A-6: Work Experience

A-6.1: In your current job, do you do any of the following:

	YES	NO
1. spray pesticides?		
2. mix pesticides?		
3. do any handling of pesticides?		
4. drive spray tractors?		
5. clean clothing or spray equipment used for pesticides?		
1. do anything else with pesticides (specify)?		

A-6.2: In the past five years, have you ever done any of the following:

	YES	NO
1. sprayed pesticides?		
2. mixed pesticides?		
3. done any handling of pesticides?		
4. drive spray tractors?		
5. cleaned clothing or spray equipment used for pesticides?		
6. done anything else with pesticides (specify)?		

A – 7: Test for Colour Blindness

READ: Some people have difficulty seeing certain colours, although this does not cause problems for the person, this may be a problem when colour is used on products. We would now like to test you for colour blindness.

A – 7.1: Is the respondent colour blind?

Yes=1	No=2

(If respondent reads #'s 8 and 29 from the 2 cards, they ARE NOT colour blind) – **tick no**
(If respondent reads #'s 3 and 70 from the 2 cards, they ARE colour blind.) – **tick yes**

B. General Pesticide Knowledge and Attitudes

B-1. I would like to know what you think poisonous means by asking you if the following are poisonous (e.g., can kill/harm you)?

	YES	NO	Don't Know
1. Snakes			
2. Cockroach chalk			
3. Blue death			
4. Diesel or petrol			
5. alcohol			
6. glue			
7. Detol or savlon			
8. Fish tins			
9. paint			
10. Empty chemical containers			
11. jik			
12. Pesticides			

13. matches			
14. Headache tablets (disprin, pando)			
15. Dips for animals			
16. Doom			

B-2. Please put the following in order from most poisonous (1) to least poisonous (4).

	Put number 1-4 here
Dirty water	
Headache tablets	
Pesticides	
Petrol	

B-3. Is the following a pesticide? (Tick answer for each)

	YES=1	**NO=2**	**Don't Know=3**
1. **vinegar**			
2. **Doom**			
3. **Omo**			
4. **Cooking Oil**			
5. **Harpic** (toilet cleaner)			
6. **Room freshners**			
7. **Dips for animals**			
8. **Vaseline**			
9. **Shampoo for lice control**			

B-4. What do you think pesticides are used for?

<u>UNPROMTED</u>: DO NOT READ LIST OF ANSWERS, BUT TICK THOSE LISTED BY RESPONDENT.
<u>PROMPTED:</u> READ LIST AND TICK YES OR NO

	Unprompted		**Prompted Yes=1**	**No=2**
1. for general cleaning (floors, surfaces)				
2. to kill crop insects				
3. to kill insects				
4. to kill weeds				
5. to produce better fruit				
6. to keep you healthy				
7. don't know				
8. Other (specify)				

Code=1

B-5. How do you believe that farm workers can come into contact with pesticides while working?

Can they come into contact: **READ LIST TO RESPONDENT**

	YES=1	**NO=2**	**Don't Know=3**
1. By touching crops or plants after pesticide have been applied?			
2. By breathing pesticides in the air?			
3. By being sprayed?			
4. By changing a light bulb?			
5. By swallowing sweat off their face?			
6. When mixing, loading or applying pesticides?			
7. By smoking or eating after spraying and before washing?			
8. By cleaning a drain?			
9. By eating plants from a sprayed field?			
10.By walking bare legged or bare foot in a sprayed field?			
11. From handling spray equipment?			
12. By wearing dirty (previously worn at work) Overalls?			
13. Other specify)			

B-6: Are all pesticides poisonous?

1_____ yes
2_____no **(If no, go to B – 6.1)**

B – 6.1: How do you know which pesticides are poisonous and which are not?

_____

_____

B-7: Are all pesticides dangerous?

1_____ yes
2_____no **(If no, go to B – 7.1)**

B-7.1: How can you tell which pesticides are dangerous and which are not?

_____

_____

C. Perceived risks from exposure to pesticides (PRP)

C-1: I would like to ask you how dangerous you feel pesticides are for you in relation to other dangers in your daily life through ranking dangers for me.

Please put the following in order from what you think is **most dangerous (1)** to **least dangerous (3)** for your health and safety if you are exposed to the following:

C -1.1:	**Rank level of danger**
1. Smoking cigarettes	
2. Drinking papsak wine	
3. Spraying pesticides	

Ranking scale is as follows:

- **most dangerous (1)**
- **moderately dangerous (2)**
- **least dangerous (3)**

C – 1.2:	**Rank level of danger**
1. Walking on a path where there are poisonous snakes.	
2. Working with pesticides.	
3. Being exposed to a person who has TB	

C - 2: Please put the following in order from what you think is **most dangerous (1)** to **least dangerous (3)** for your children's health and safety if they are exposed to the following:

	Rank level of danger
1. The child breathing in someone else's cigarette smoke	
2. The child swimming in a dam	
3. The child playing in a field sprayed that morning with pesticides	

C – 3: Do you feel that pesticides can harm your health (make you sick)?

1_____ yes
2_____ no
3_____ don't know

C – 4: If you are exposed to pesticides, what can happen to you? **Do not read list.**

	Tick one
1. I can become sick.	
2. Nothing.	
3. Damage my skin.	
4. I can have health problems later in my life.	
5. Don't know	
6. Damage my lungs	
7. Other (specify)	

C – 5: Do you think that pesticides can harm the health of your children?

1_____ yes
2_____ no
3_____ don't know

C – 6: Do you think that pesticides used at work can harm the health of your co-workers?

1_____ yes
2_____ no
3_____ don't know

C – 7: Do you think that you need to protect yourself from exposure to pesticides when working?

1_____yes **(If yes, go to question C-7.1)**
2_____no **(If no, go to C-8)**
3_____don't know **(If don't know, go to C-8)**

C – 7.1: If yes, why do you feel you must protect yourself? **(Go to C - 7.2)**

_____
_____

C – 7.2: How would you protect yourself from exposure to pesticides?

_____
_____

C - 7.3: If you do not have protective equipment available would you still work with pesticides?

1_____ yes **(IF YES, go to C – 7.3.1)**
2_____ no

C – 7.3.1: If yes, why?

_____

_____

C – 8: Do you think it is possible that the health of unborn children of pregnant farm workers can be harmed by pesticides?

1_____ yes
2_____ no
3_____ don't know

C – 9: Do you think it is possible that the ability for farm workers to have children can be influenced (affected or hurt) by pesticides?

1_____yes
2_____no
3_____don't know

C - 10: Do you think that washing your hands can reduce exposure to the harmful effects from pesticides?

1 _____ Yes **(If yes, go to C - 10.1)**
2 _____ No **(If no, go to D – 1)**
3 _____ Don't know **(If don't know, go to D – 1)**

C – 10.1: When should you wash your hands to reduce the harmful effects from pesticides?

<u>UNPROMPTED:</u> DO NOT READ THE LIST, BUT TICK ALL ANSWERS MENTIONED.
<u>PROMPTED:</u> READ LIST AND TICK YES OR NO.

	Unprompted		Prompted Yes=1	Prompted No=2
1. **(For prompted ask, "Does..)** washing hands does not reduce effects				
2. before eating				
3. before smoking				
4. before going to the toilet				
5. before going home				
6. after work				
7. before touching anything				
9. other (specify)				

Code=1

C – 11: Can all pesticides make you sick?

1_____ yes
2_____no **(If no, go to C – 11.1)**
3_____ don't know **(If don't know, go to C-11.1)**

C – 11.1: How can you tell which pesticides will make you sick and which won't?

_____

_____

C – 12: [Ask the following questions and tick yes or no.]

	YES=1	NO=2
1. Can all pesticide make you sick straight away?		
2. Can some pesticides make you sick years from now?	**[If yes, go to C – 12. 1]**	

C – 12.1: If some pesticides can make you sick now and some later, which pesticides are the worst for your health: **[tick only one]**

1. those pesticides which make you sick immediately _____
2. those pesticides that make you sick in the future _____

D. Predictor Variable

I would like to now ask you some questions about information or training you have received about how to work safely with pesticides. This information could be a poster, a brochure or a book someone has given you or told you to read. Training could be a video or presentation or a workshop that has told you about how to work safely.

D – 1: Have you ever received any information or training on how to prevent or reduce your exposure to pesticides while you are working?

1_____ yes (**go to D – 1.1**)
2_____ no (**If no, go to Section E**)
3_____ don't know (**If don't know, go to Section E**)

D – 1.1: If Yes, have you received information or training this year on how to prevent or reduce your exposure to pesticides when working?

1_____ yes
2_____ no (**If no, go to E – 1**)
3_____ don't know (**If don't know, go to E – 1**)

D – 1.2: Where did you receive the information from? **Tick answer(s)**

1. other farm workers	
2. the farm manager/owner	
3. agricultural extension officers	
4. supervisor	
5. the pesticide label	
6. Other (specify)	

D – 1.3: Did the training include any information on pesticide use, pesticide handling and precautions to use with pesticides?

1_____ yes
2_____ no
3_____ don't know

D – 2: Where do you get information about pesticide health hazards from?
D – 2.1: Where do you get information about pesticide first aid from?
D – 2.2: Where do you get information about pesticide safety from?
D – 2.3: Where do you get information about precautions from?

	D-2: Health Hazards	**D-2.1: First Aid**	**D-2.2: Safety**	**D-2.3: Precautions**
1. other farm workers				
2. the farm manager/owner				
3. agricultural extension officers				
4. supervisor				
5. the pesticide label				
6. Other (specify)				

D – 2.4: Circle the number (1 – 6) in **D - 2** from the person/place where the respondent most often gets pesticide information from?

D – 3: Have you received any training on legislation/regulations to do with the health and safety of working with chemicals?

1 _____ Yes **(If yes, go to D – 3.1)**
2 _____ No

D – 3.1: Which legislation/regulations have you received training about?

	Yes=1	No=2
1. Hazardous Chemical Substances regulations		
2. Labour relations Act		
3. Other (specify)		

E. Perceived message of hazard information found on pesticide label (PMI)

Instruction: The four labels to be used for the next questions are:
Red Label: Azinphos- Methyl 350 WP
Green Label: Glean 75 DF
Blue Label: Dithane M-45 800 WP
Yellow Label: Gramoxone

E –1 : Show respondent any of the four labels and ask: Do you know what this is?

1_____ yes (Go to **E – 1.1)**

2_____ no **(Tell the person it is called a "label" which is found on pesticide containers, then Go to E – 2)**

3_____ don't know **(Tell the person it is called a "label" which is found on pesticide containers, then Go to E – 2)**

E – 1.

1 If yes, what is it? **DO NOT READ LIST TO RESPONDENT. Probe with "is it anything else?"**

	Tick one
1. a piece of paper	
2. information	
3. label	
4. etiket	
5. don't know	
6. other (specify)	

E – 2: Why do pesticide containers have labels on them (what is the label used for)? **DO NOT READ LIST TO RESPONDENT. Keep asking if there is anything else until the person says no.**

	Tick answers given
1. don't know	
2. For instructions and Measurements (what crops to use it on and how much to apply)	
3. for first aid information	
4. for warnings and precautions of dangers	
5. For knowing when to harvest a crop after using the pesticide	
6. For how to dispose of an empty pesticide container	
7. For the re-entry intervals	
8. for what protective equipment to use	
9. Other (specify)	

E – 3: In the past year, have you used the information on a pesticide label at work or home?

1_____ yes (If yes, Go to **E – 3.1)**
2_____ no (If no, go to **E – 4)**
3_____ don't know (If don't know, go to **E – 4)**

E – 3.1: If yes, what did you use the information for?
DON'T READ LIST TO RESPONDENT.

	Tick answers given
1. don't know	
2. For instructions and measurements	
3. for first aid information	
4. for warnings and precautions	
5. For knowing when to harvest a crop after using the pesticide	
6. For how to dispose of an empty pesticide container	
7. for what protective equipment to use	
8. Other (specify).....	

E – 4: Do you think that... **(tick one answer for each question)**

	YES=1	NO=2	Don't know=3
1. the information found on pesticide labels is always correct?			
2. the information found on pesticide labels is sometimes wrong?			
3. the people who wrote the information on pesticide labels are trustworthy and tell the truth?			
4. the people who put the information on the pesticide labels tell lies?			
. pesticide labels are a good source of information for protecting yourself?			
6. pesticide labels are not very helpful in protecting yourself and others against exposure to pesticides?			

Please answer the following questions after looking at the red label.

E –5: Is there anything on this label which tells you that the pesticide is dangerous?

1_____ yes (go to **E – 5.1)**
2_____ no
3_____ don't know

E – 5.1: If yes, what? **Tick as many answers as respondent says.**

	Code =1
1. the colour red	
2. the skull and cross bones	
3. the lock away & keep out of reach of children pictogram	
4. wear boots pictogram	
5. wear respirator pictogram	
6. wear goggles pictogram	
7. wear gloves pictogram	
8. the words "very toxic"	
9. the wash hands pictogram	
10. dangerous to livestock & poultry pictogram	
11. dangerous to fish & water bodies pictogram	
12. dangerous to wildlife & birds pictogram	
13. Other (specify)	

E – 6: By looking at this label, can you tell whether it is less or more dangerous than other pesticides?

1_____ yes (go to **E – 6.1)**
2_____ no
3_____ don't know

E – 6.1 If yes, what tells you that the pesticide is less or more dangerous than other pesticides?

_____

_____

E – 7: Please put the following labels in order from most dangerous (1) to least Dangerous (4).
(Give the respondent the four labels. Write number of order in table below)

Order respondent put labels in. List number from 1 to 4.

1.Yellow label	
2. Green label	
3. Red label	
4. Blue label	

Pesticide labels have pictograms on them (little pictures).

E – 8: Have you seen any of these pictograms (below) on a pesticide labels before?
Tick yes or no on table below

E – 9: What do the pictograms on the pesticide label mean to you? I will show you a pictogram and ask you to please say what you think it means.
Write respondents answers on the table below. Probe for answers. Do not accept answers that don't make sense. Ask respondent to explain what they mean by their answer.

The following pictograms are found on pesticide labels. Please briefly describe what each means to you when you see it on a pesticide label:

E – 9: PICTOGRAM RESPONDENT'S DEFINITION Tick here if seen before	yes	no		
1. 				
2. 				
3. 				
4. 				
5. 				
6. 				
7. 30/12/2005 				
8. 				
 9.				
10. 				

INSTRUCTION: Show respondent all 4 labels with the colour codes on them.

E – 10: What do you think these colours are telling you? Why are they on pesticide labels?

DO NOT READ LIST.

	Tick answer(s) here
1) Don't know	
2) Part of the label design	
3) Indicates warning/danger	
4) Shows that the pesticide kills pests	
5) Colour of the company that makes the pesticides	
6) Shows toxicity of the pesticide	
7) Other (fill in):	

E – 11: Have you noticed these colours on pesticide labels before?

1_____ yes **(If yes, go to E – 11.1)**
2_____no

E – 11.1: Tick on table below which colours the respondent has noticed before on a label.

E –12: What do the following colours found on pesticide labels mean to you? **Write respondent's answers on the table below.**

COLOURS	Seen before		RESPONDENT'S DEFINITION	
	yes	**no**		
1. yellow				
2. green				
3. red				
4. blue				

Code

HOW TO USE THE INFORMATION ON A PESTICIDE LABEL AND INFORMATION INSERT

INSTRUCTION:

- ***Use the yellow label and the information insert that comes with it.***
- Show the label and information insert to the respondent and ask the following questions:

E – 13: What is the name of the pesticide? **[DO NOT READ LIST]**

☐ Tick here if respondent needed an explanation

	Tick one
1. Syngenta	
2. Glean	
3. Paraquat	
4. Gramoxone	
5. Herbicide	
6. As dichloride salt	
7. Don't know	
8. Other (fill in name)	

E – 14: What is the active ingredient of this pesticide?

☐ Tick here if respondent needed an explanation

	Tick one
1. Syngenta	
2. Glean	
3. Paraquat	
4. Gramoxone	
5. As dichloride salt	
6. There isn't one	
7. Don't know	
8. Other (fill in name)	

E – 15: Is there a colour code on this label?

1_____ yes (**go to E – 15.1**)
2_____ no
3_____ don't know

E – 15.1: If yes, what colour is it?

	Tick only one
1. Blue	
2. White	
3. Orange	
4. Yellow	
5. Black	
6. Red	
7. Green	
8. Purple	
9. Don't know	

E-16: What does the word "HARMFUL" on this label tell you?

_____

_____

E-17: On this label, it states: "***Avoid contamination of food, feed, drinking water and eating utensils***".

[POINT TO THIS SENTENCE ON LABEL 2 UNDER PRECAUTIONS].

E-17.1: What does "avoid contamination of food" mean?

_____

_____

E-17.1(a): How would you "avoid" contamination of food when using this pesticide?

_____

_____

E-17.2: What are "eating utensils"?

_____

_____

E-17.2(a): How would you "avoid" contamination of eating utensils when using this pesticide?

_____

_____

E-18: On this label, it states: ***"Dispose of wash water where it will not contaminate crops, grazing, rivers or dams"***.

[POINT TO THIS SENTENCE ON LABEL 2 UNDER PRECAUTIONS].

E – 18.1: What does "dispose of wash water" mean to you?

_____

_____

E –18.1(a): Where would you "dispose" of this wash water so as not to contaminate crops, grazing rivers or dams?

_____

_____

Instruction: Hand respondent the **blue label:** Dithane M-45 800 WP

E-19: According to this label, what precautions must you take when using this pesticide?

DO NOT READ LIST, TICK ANSWERS MENTIONED.

	tick
1. avoid contact (touching) with skin	
2. avoid contact with eyes	
3. avoid contact with clothes	
4. do not inhale dust or spray mist	
5. wear face mask and rubber gloves when mixing pesticide	
6. wash contaminated clothes	
7. do not spray over water or allow spray to drift onto water	
8. prevent contamination of food, feeds, drinking water & eating utensils	
9. destroy empty container by perforation	
10. other (specify)	

E-20: According to this label, should you burn the pesticide container when it is empty?

1_____ yes
2_____ no
3_____ don't know

On this label, it states:
"Destroy empty container by perforation and flattening and never use for any purpose."

E – 21: What does "perforation" mean?

	Tick Only One
1. never heard of the word before	
2. don't know	
3. burn	
4. bury	
5. crush	
6. make holes in it	
7. other (specify)	

F: Protective Behaviors

F – 1: What do you think are the possible harmful effects from pesticides at work for you and your co-workers? **(list below; keep asking "anything else?")**

_____

_____

F – 2: How easy is it for you to prevent possible harmful effects from pesticides:

- **F – 2.1:** For yourself at work? Would you say....**READ LIST and tick one**
  1. _____ very easy
  2. _____ moderately easy
  3. _____ not easy at all

- **F – 2.2:** For your co-workers? Would you say....**READ LIST and tick one**
  1. _____ very easy
  2. _____ moderately easy
  3. _____ not easy at all

➢ **F – 2.3:** At home? Would you say....**READ LIST and tick one**

1. _____ very easy
2. _____ moderately easy
3. _____ not easy at all

F – 3: Do you do anything to protect yourself from exposure to pesticides?

1 _____ YES **(If yes, go to F – 3.1)**
2_____ NO

F – 3.1: If yes, list what do you do?

_____

_____

F – 4: Do you use personal protective equipment (PPE) in your current job?

1_____ Yes **(If yes, go to F-4.1)**
2_____ No

F – 4.1: How often do you use PPE when working with pesticides?

	Tick one
1. sometimes	
2. every time	
3. never	

F-4.2: Why do you wear PPE?

	tick
1. because I was told to by the farm manager/employer	
2. because I don't want to get sick	
3. because the pesticide is dangerous	
4. because the other workers wear PPE	
5. other (specify).....	

F-5: Do you believe that PPE protects you from all possible pesticide health effects?

1_____ Yes
2_____ No
3_____ Don't know

G. POISONING EXPERIENCE

G – 1: Have you ever been sick from working with pesticides?

1_____ Yes
2_____ No
3_____ Don't know

G – 2: What does it mean to be "poisoned by pesticides"?

_____
_____

G – 3: Have you ever been poisoned by pesticides?

1_____ Yes **(If yes, go to G – 3.1)**
2_____ No **(If no, go to G –4)**
3_____ Don't Know

G – 3.1: How do you think you were poisoned?

_____
_____
____

G – 3.2: Did you go to a doctor/clinic?

1_____ Yes
2_____ No

G – 3.3: Did you continue to work when you were sick?

1_____ Yes
2_____ No

G-4: Has anyone you ever worked with has been poisoned?

1_____ Yes
2_____ No

G-5: Have any of your family members been poisoned?

1_____ Yes
2_____ No

Thank you for taking the time to answer these questions for me. Here is a card which tells you what some of the pictures and colours mean on pesticide labels. Please use the card to help you understand the pesticide labels for all the pesticides you use at work and at home.

APPENDIX B:
FARM WORKER QUESTIONNAIRE IN AFRIKAANS

PLAASWERKER PLAAGDODER ETIKET VRAELYS
Weskaap 2003

Respondent Nommer: ☐☐☐ **Datum :** ☐☐☐

Ondervraer voorletters: _____

Landbou sektor: ☐ **Vrugte** ☐ **Wyn** ☐ **Ander** _____

Area waar plaas geleë is: _____

Toestemming: Die toestemmingsvorm was gelees deur of vir die respondent en hulle verstaan dat deelname vrywillig is en het ingestem om deel te neem in die studie.
Merk ☐

A. Algemene Agtergrond

A –1. Geslag: **Vroulik** ☐ **Manlik** ☐

A- 2. Ouderdom/GEB: _____

A-3. Onderrigvlak: (merk een – hoogste vlak bereik)

1) Geen formele onderrig ☐
2) Het nie laerskool voltooi nie ☐
3) Het laerskool voltooi ☐
4) Het nie hoërskool voltooi nie ☐
5) Het hoërskool voltooi ☐
6) Het nie tersiêre onderrig voltooi nie ☐
7) Tersiêre onderrig: ☐
☐

8) Ander (spesifiseer)_____

A-4. Letterkundigheid

	Nee	'n Bietjie	Baie goed (vlot)
1) Kan u Afrikaans praat?			
2) Kan u Afrikaans lees?			
3) Kan u Afrikaans skryf?			
4) Kan u Engels praat?			
5) Kan u Engels lees?			
6) Kan u Engels skryf?			

A-5. Beroep/werk titel

A-5.1: Watter werk doen u op die oomblik?

Merk antwoord(e)	JA	NEE
1) Spuitman (sluit spuit menger, spuit bestuurder in)		
2) Voorman of toesighouer		
3) Algemene werker		
4) Trekker drywer of bestuurder		
5) Ander (spesifiseer)		

A-5.2: Hoe lank werk u in hierdie posisie op die plaas?

_____ Jare (of die jaar waarin begin is)
_____ Maande

A-6: Werk Ondervinding

A-6.1: In u huidige werk doen u enige van die volgende:

	Ja	Nee
1) spuit plaagdoders?		
2) meng plaagdoders?		
3) enige hantering van plaagdoders?		
4) bestuur die spuit trekker?		
5) maak klere of spuit toerusting skoon wat gebruik was vir plaagdoers?		
6) doen enige iets anders met plaagdoders (spesifiseer)?		

A-6.2: In die verlede het u enige van die volgende gedoen:

	Ja	Nee
1. spuit plaagdoders?		
2. meng plaagdoders?		
3. enige hantering van plaagdoders?		
4. bestuur die spuit trekker?		
5. maak klere of spuit toerusting skoon wat gebruik was vir plaagdoers?		
6. doen enige iets anders met plaagdoders (spesifiseer)?		

A – 7: Toets vir Kleurblinheid

LEES: Sommige mense het 'n probleem om sommige kleure te sien, alhoewel dit nie 'n probleem vir die persoon is nie, mag dit dalk 'n probleem wees wanneer kleure op produkte gebruik word. Ons wil u graag toets vir kleurblindheid.

A – 7.1: Is die persoon kleurblind?

- (As die respondent #'s 8 en 29 van kaard 2 lees, is hulle NIE kleurblind nie) **merk nee** ☐ **Nee** (2)
- (As die respondent #'s 3 en 70 van kaard 2 lees, IS hulle kleurblind) **merk ja** ☐ **Ja** (1)

B. ALGEMENE KENNIS EN HOUDING TEENOOR PLAAGDODERS

B-1. Ek wil graag weet wat giftig beteken vir u, deur te vra of die volgende giftig is (bv., kan u dood maak/seer maak)?

	JA	NEE	Weet nie
1) slange			
2) Kokkerote kruit			
3) Blue death			
4) diesel of petrol			
5) alkohol			
6) gom			
7) Detol of savlon			
8) vis blikkies			
9) verf			
10) leë chemikalieë houers			
11) jik			

12) plaagdoders			
13) vuurhoutjies			
14) hoofpyn tablette (disprin, panado)			
15) dip vir diere			
16) plante			
17) Muskiete spiraal (coils)			
18) Doom			

B-2. Plaas die volgende in orde van mees giftig (1) tot minder giftig (4).

	Plaas nommer 1-4 hier
Vuil water	
Hoofpyn tablette	
Plaagdoders	
Petrol	

B-3. Is die volgende 'n plaagdoder? (Merk 'n antwoord vir elke een)

		Ja	**Nee**	**Weet Nie**
1)	**asyn**			
2)	**Doom**			
3)	**Omo**			
4)	**Kookolie**			
5)	**Harpic** (toilet cleaner)			
6)	**Kamer vervrissers** (Room freshners			
7)	**Dip vir diere**			
8)	**Vaseline**			
9)	**Sjampoe om luise te beheer**			

B-4. Waarvoor dink u word plaagdoders gebruik?

<u>GEMELD</u>: MOENIE DIE LYS LEES NIE, MAAR MERK AF WAT DEUR DIE RESPONDENT GENOEM WORD.
<u>ONGEMELD:</u> LEES DIE LYS EN MERK JA OF NEE.

	Gemeld		**Ongemeld**	
			Ja	**Nee**
1) vir algemene skoon maak (vloere, oppervlaktes)				
2) om gewas insekte dood te maak				
3) om insekte dood te maak				
4) om onkruid dood te maak				
5) om beter vrugte te produseer				

6) om u gesond te hou				
7) weet nie				
8) ander (spesifiseer)				

code

B-5. Hoe dink u kan plaaswerkers in kontak kom met plaagdoders gedurende hul werk?

Kan u in kontak kom.....: **LEES DIE LYS VIR DIE RESPONDENT**

	Ja	**Nee**	**Weet nie**
1) deur gewasse of plante aan te raak nadat deur plaagdoders bespuit is?			
2) deur plaagdoders in te asem wat in die lug is?			
3) deur gespuit te word?			
4) deur 'n gloeilamp te vervang?			
5) deur sweet in te sluk wat op die gesig is?			
6) wanneer plaagdoders gemeng, gelaai of gespuit word?			
7) deur te rook of te eet nadat gespuit was en voor daar gewas word?			
8) deur 'n drein skoon te maak?			
9) deur plante te eet nadat dit gespuit is?			
10) deur kaalvoet of kaal bene deur 'n veld wat gespuit was te loop?			
11) deur spuit toerusting te hanteer?			
12) deur vuil oorpakke (wat voorheen by die werk gedra was) te dra?			
13) Ander (spesifiseer)			

B – 6: Is alle plaagdoders giftig?

1_____ja
2_____nee (**gaan na B – 6.1)**

B – 6.1: Hoe weet u watter plaagdoders giftig is of nie?

_____
_____

B – 7: Is alle plaagdoders gevaarlik of nie?

1_____ja
2_____nee **(gaan na B – 7.1)**

B – 7.1: Hoe weet u watter plaagdoders is gevaarlik en watter nie?

C. Beskoude risikos deur blootstelling aan plaagdoders (PRP)

C – 1: Ek wil graag weet hoe gevaarlik u dink plaagdoders in u lewe is met verhouding tot ander gevare in u daaglikse lewe deur dit vir my te rangskik.

Vir u gesondheid en veiligheid, plaas asseblief die volgende in orde van wat u dink is: **mees gevaarlik (1)** tot die **minste gevaarlik (3)** vir u as u blootgestel word aan die volgende:

C -1.1:	**Rangskik vlak van gevaar**
1) sigaret rook	
2) drink papsak wyn	
3) spuit plaagdoders	

Rangskik skaal soos volg:

- **Mees gevaarlik (1)**
- **matiglik gevaarlik (2)**
- **minste gevaarlik (3)**

C – 1.2:	**Rangskik vlak van gevaar**
1) om op 'n pad te loop waar daar giftige slange is.	
2) Werk met plaagdoders.	
3) Deur blootgestel te word aan 'n persoon met TB	

C - 2: Plaas asseblief die volgende in die orde wat u dink **mees gevaarlik (1)** tot **minste gevaarlik (3)** vir u kinders se gesondheid as hulle daaraan blootgestel word:

	Rangskik vlak van gevaar
1) 'n Kind wat iemand se sigaret rook in asem	
2) 'n Kind wat in 'n dam swem	
3) 'n Kind wat in 'n veld speel wat deur plaagdoders daardie oggend gespuit is	

C – 3: Voel u dat plaagdoders u gesondheid kan beïnvloed (u siek maak)?

1_____ja
2_____nee
3_____weet nie

C – 4: As u blootgestel is aan plaagdoders, wat kan met u gebeur? **Moenie die lys lees nie.**

	Merk een
1) Ek kan siek raak.	
2) Niks.	
3) Ek kan gesondheids probleme ontwikkel later in my lewe.	
4) Weet nie	
5) Skadelik vir my longe	
6) Ander (spesifiseer)	

C – 5: Dink u dat plaagdoders u kinders se gesondheid aan tas?

1_____ja
2_____nee
3_____weet nie

C – 6: Dink u dat die plaagdoders wat gebruik word kan die gesondheid van u mede-werkers aan tas?

1_____ja
2_____nee
3_____weet nie

C – 7: Dink u dat u moet uself beskerm teen plaagdoders wanneer u werk?

1_____ ja **(Indien ja, gaan na C-7.1)**
2_____nee **(Indien nee, gaan na C-8)**
3_____weet nie **(Indien weet nie, gaan na C-8)**

C – 7.1: Indien ja, hoekom dink u moet u uself beskerm? **(gaan na C – 7.2)**

_____
_____

C – 7.2: Hoe sal u uself beskerm teen blootstelling aan plaagdoders?

_____
_____

C - 7.3: Indien u nie beskermingstoetusting het wanneer u werk nie sal u nog steeds met plaagdoders werk?

1_____ ja **(Indien ja, gaan na C – 7.3.1)**
2_____ nee

C – 7.3.1 Indien ja, hoekom?

_____

_____

C – 8: Dink u dat die gesondheid van ongebore babas van verwagtende plaaswerkers kan geaffekteer word deur plaagdoders?

1_____ ja
2_____ nee
3 _____ weet nie

C – 9: Dink u dat die moontlikheid van plaaswerkers om kinders te kry kan beïnvloed (geaffekteer of beseer) word deur plaagdoders?

1_____ja
2_____nee
3_____ weet nie

C - 10: Dink u dat die negatiewe gevolge van blootstelling aan plaagdoders kan verminder word deur u hande te was?

1 _____ ja **(Indien ja, gaan na C - 10.1)**
2 _____ nee **(Indien nee, gaan na D – 1)**
3_____Weet nie **(Indien weet nie, gaan na D –1)**

C – 10.1: Wanneer moet u u hande was om die negatiewe effekte van plaagdoders te verminder?

<u>GEMELD:</u> MOENIE DIE LYS LEES NIE, MAAR MERK DIE ANTWOORDE WAT GEGEE WORD.
<u>ONGEMELD:</u> LEES DIE LYS EN MERK JA OF NEE.

	Gemeld		Ongemeld Ja	Nee
1. **(Vir ongemeld vra, "Sal"...)** die was van hande verminder nie die effekte nie				
2. voor u eet				
3. voor u rook				
4. voor u toilet toe gaan				
5. voor u huis toe gaan				
6. na werk				
7. voor u enige iets aan raak				
8. ander (spesifiseer)				
		code		

C – 11: Kan alle plaagdoders u siek maak?

1_____ja
2_____ nee **(Indien nee, gaan na C – 11.1)**
3_____weet nie **(Indien weet nie, gaan na C – 11.1)**

C – 11.1: Hoe weet u watter plaagdoders u siek sal maak en watter nie?

_____

_____

C – 12: [Vra die volgende vrae en merk ja of nee.]

	JA	NEE
1. Kan alle plaagdoders u dadelik siek maak?		
2. Kan sommige plaagdoders u siek maak jare van nou af?	**[Indien ja, gaan na C – 12. 1]**	

C – 12.1: Indien sommige plaagdoders u nou kan siek maak en sommige later, watter is die slegter vir u gesondheid: **[merk net een]**

1. daardie plaagdoders wat u onmiddelik siek maak _____
2. daardie plaagdoeders wat u in die toekoms kan siek maak _____

D. VOORSPELLINGS VARIASIE

Ek wil u nou vra oor informasie of opleiding wat u gekry het oor hoe om veilig met plaagdoders te werk. Hierdie informasie kan 'n plakaat, 'n brosure of 'n boek wees wat iemand u gegee het of vir u gegee het om te lees. Opleiding kan u video of presentasie of 'n werkswinkel wees wat vir u gesê het hoe om veilig te werk.

D – 1: Het u al ooit informasie of opleiding gekry oor hoe om te voorkom of blootstelling te verminder wanneer u met plaagdoders werk?

1_____ ja **(Indien ja, gaan na D – 1.1)**
2_____ nee **(Indien nee, gaan na Afdeling E)**
3 _____ weet nie **(Indien weet nie, gaan na Afdeling E)**

D – 1.1: Indien JA, het u hierdie jaar informasie of oplieding gekry oor hoe om blootstelling te verminder of te voorkom wanneer u met plaagdoders werk?

1_____ ja
2_____nee **(Indien nee, gaan na E – 1)**
3 _____weet nie **(Indien weet nie, gaan na E – 1)**

D – 1.2: Waar het u die informasie gekry? **Merk antwoord(e)**

1. ander plaaswerkers	
2. die plaas bestuurder/eienaar	
3. landbou uitreikings offisier	
4. voorman	
5. plaagdoders etiket	
6. ander (spesifiseer).....	

D – 1.3: Het die opleiding informasie ingesluit oor hoe om die plaagdoders te gebruik, te hanteer en voorsorgmaatreëls wanneer jy plaagdoders gebruik?

1_____ ja
2_____ nee
3 _____weet nie

D –2: Van waar kry u informasie oor plaagdoders risikos?
D –2.1: Van waar kry u informasie oor plaagdoders eerste hulp?
D –2.2: Van waar kry u informasie oor plaagdoder veiligheid?
D –2.3: Van waar kry u informasie oor en voorsorgmaatreëls?

Moenie die lys lees nie, maar merk die antwoorde wat gegee word.

	D-2: Gesondheids Risikos	**D-2.1: Eerste Hulp**	**D-2.2: Veilighied**	**D-2.3: Voorkoming**
1. ander plaaswerkers				
2. die plaas bestuurder/eienaar				
3. landbou uitreikings offisier				
4. voorman				
5. plaagdoders etiket				
6. ander (spesifiseer)				

D – 2.4: Omring die letter (1 - 6) in **D - 2** om an te wys waar/of van wie die persoon die meeste informasie oor plaagdoders kry?

D – 3: Het u enige opleiding gekry oor wette/regulasies wat te doen het met veiligheid en gesondheid wanneer met chemikalieë gewerk word?

1 _____ ja **(Indien ja, gaan na D – 3.1)**
2 _____ nee

D – 3.1: Watter wette/regulasies het u opleiding oor gekry?

1. Regulasies Vir Gevaarlike Chemiese Substansies	
2. Werkers verhoudings Wet	
3. Ander (spesifiseer)	

E. Beskoude boodskap oor gevaar informasie op plaagdoder etiket (PMI)

Instruksie: Die vier etikette vir die volgende vraag is:
Rooi etiket: Azinphos- Methyl 350 WP
Groen etiket: Glean 75 DF
Blou etiket: Dithane M-45 800 WP
Geel etiket: Gramoxone

E –1 : Wys vir die respondent enige van die vier etikette en vra: Weet u wat dit is?

1_____ ja **(Indien ja, gaan na E – 1.1)**

2_____ nee **(Sê aan die persoon dat dit 'n "etiket" genoem word, wat op plaagdoder houer gevind word, gaan dan na E – 2)**

3 _____weet nie **(Sê aan die persoon dat dit 'n "etiket" genoem word, wat op plaagdoder houer gevind word, gaan dan na E – 2)**

E – 1.1 Indien ja, wat is dit?
MOENIE DIE LYS AAN DIE RESPONDENT LEES NIE.
Vra, "einge iets meer?"

	Merk een
1. 'n stukkie papier	
2. informasie	
3. etiket	
4. weet nie	
5. ander (spesifiseer)	

E – 2: Hoekom het plagdoder houers etikette op hulle (waarvoor word die etiket gebruik)?

MOENIE DIE LYS VIR DIE RESPONDENT LEES NIE.

Vra aanhoudend is daar enige iets verder tot nee gesê word.

	Merk antwoorde
1. weet nie	
2. vir instruksies en afmetings (op watter gewasse dit kan gebruik word en hoeveel om op te sit)	
3. vir eerste hulp informasie	
4. vir waarskuwings en voorsorg vir gevare	
5. om te weet wanneer om te oes na die plaagdoder gespuit was	
6. Vir hoe om onslae te raak van leë plaagdoder houers	
7. Vir wanneer om in te gaan nadat daar gespuit is	
8. Vir watter beskermingsklere om te gebruik	
9. Ander (spesifiseer)	

E – 3: Gedurende die afgelope jaar, het u die informasie op die plaagdoder etiket gebruik?

1_____ ja **(Indien ja, gaan na E- 3.1)**
2_____nee **(Indien nee, gaan na E – 4)**
3 _____weet nie**(Indien weet nie, gaan na E – 4)**

E – 3.1: Indien ja, vir wat het u die informasie gebruik?

MOENIE DIE LYS LEES VIR DIE RESPONDENT NIE.

	Merk antwoorde
1. weet nie	
2. vir instruksies en afmeting	
3. vir eerste hulp informasie	
4. vir waarskuwiings en voorkomingsmaatreëls	
5. om te weet wanneer om te oes nadat die plaagdoders op die gewas gebruik was	
6. om te weet hoe om ontslae te raak van leë plaagdoder houers	
7. vir watter beskermings toerusting om te gebruik	
8. ander (spesifiseer)	

E – 4: Dink u dat die... (**merk antwoorde vir elke vraag)**

	Ja	Nee	Weet Nie
1. Die informasie op die plaagdoder etiket altyd korrek is?			
2. Die informasie op die plaagdoder etiket soms verkeerd is?			
3. Die mense wat die informasie op die etiket geskryf het is betroubaar en vertel die waarheid?			
4. Die mense wat die informasie op die etiket gesit het vertel leuns?			
5. Die plaagdoder etiket is 'n goeie bron van informasie?			
6. Die plaagdoder etiket is nie baie hulpvaardig om jouself en andere te beskerm teen blootstelling aan plaagdoders nie?			

Antwoord asseblief die volgende vrae nadat u na die <u>rooi etiket</u> gekyk het.

E –5: Is daar enige iets op hierdie etiket wat sê dat die plaagdoder gevaarlik is?

1_____ ja **(Indien ja, gaan na E – 5.1)**
2_____nee
3_____ weet nie

E – 5.1: Indien ja, wat?

_____

_____

E – 6: Deur na die etiket te kyk, kan u sê of dit meer gevaarlik of minder gevaarlik is as ander plaagdoders?

1_____ja **(Indien ja, gaan na E – 6.1)**
2_____nee
3 _____weet nie

E – 6.1 Indien ja, wat sê vir jou dat dit meer of minder gevaarlik is as ander plaagdoders?

_____

_____

E – 7: Plaas asseblief die etikette in volgorde van minste gevaarlik (1) tot mees gevaarlik (4).
(Gee die respondent die vier etikette. Lys die orde kombinasie 1-4 op die tabel onder.)

	Orde nommer
Geel etiket	
Groen etiket	
Rooi etiket	
Blou etiket	

Plaagdoder etikette het piktogramme op hulle (klein prentjies).

E – 8: Het u enige van die piktogrmme (onder) op 'n plaagdoder etiket voorheen gesien? **Merk ja of nee op die tabel onder.**

E – 9: Plaagdoder etikette het piktogramme op hulle (klein prentjies). Wat beteken die prente op die etkette vir u.? Ek sal u die prente wys en u vra wat u dink dit beteken wanneer u dit op 'n plaagdoder etiket sien.

Die volgende prente word op plaagdoder etikette gesien. Beskryf asseblief kortliks wat elke een vir u beteken wanneer u dit op 'n plaagdoder etiket sien:

E – 9: **PIKTOGRAM**	**Voorheen gesien**		**RESPONDENT SE DEFINISIE**
1. 	**Ja**	**Nee**	
2. 			
3. 			
4. 			
5. 			
6. 			
7. 			
8. 			
9. 			
10. 			

kode

INSTRUKSIE: Wys vir die respondent al 4 etikette met die kleur kodes daarop.

E – 10: Kyk na die volgende kleur kodes wat op plaagdoder etikette gesien wrod.

Wat dink u sê hierdie kleure vir u? Hoekom is hulle op plaagdoder etikette?
MOENIE DIE LYS LEES NIE.

	Merk
1) Weet nie	
2) Deel van die etiket ontwerp	
3) Wys aan op waarskuwings/gevaar	
4) Wys aan dat plaagdoder diere dood maak	
5) Die kleur van die maatskappy wat die plaagdoder maak	
6) Wys hoe toksies (gevaarlik) die plaagdoder is	
7) Ander (vul in):	

E – 11: Het u al hierdie kleure op plaagdoder etikette gesien?

1 _____ ja (**Indien ja, gaan na E –11.1)**
2 _____ nee

E – 11.1: Merk op die tabel onder watter kleure die repondent voorheen op etikette gesien het.

E –12: Wat beteken die volgende kleure vir u?

KLEURE	Voorheen gesien		RESPONDENT SE DEFINISIE	
	Ja	**Nee**		
geel				
groen				
rooi				
blou				

kode

HOE OM DIE INFORMASIE OP DIE PLAAGDODER ETIKET EN INFORMASIE INSETSEL TE GEBRUIK

INSTRUKSIE:

- ***Gebruik <u>geel etiket</u> en die informasie insetsel wat daarmee gepaard gaan.***
- **Wys die etiket en die informasie insetsel aan die respondent en vra die volgende vra**:

E – 13: Wat is die naam van die plaagdoder? **[MOENIE DIE LYS LEES NIE]**

☐ Merk hier indien die respondent 'n verduideliking nodig gehad het

	Merk een
1. Syngenta	
2. Glean	
3. Paraquat	
4. Gramoxone	
5. Herbicide	
6. As dichloride salt	
7. Weet nie	
8. Ander (Vul die naam in)	

E – 14: Wat is die aktiewe bestandeel in die plaagdoder?

☐ Merk hier indien die respondent 'n verduideliking nodig gehad het

	Merk een
1. Syngenta	
2. Glean	
3. Paraquat	
4. Gramoxone	
5. As dichloride salt	
6. Daar is nie een nie	
7. Weet nie	
8. Ander (Vul die naam in)	

E – 15: Is daar 'n kleur kode op die etiket?

1_____ ja (**Indien ja, gaan na E – 15.1**)
2_____nee
3_____weet nie

E – 15.1: Indien ja, watter kleur is dit?

	Merk een
1. Blou	
2. Wit	
3. Oranje	
4. Geel	
5. Swart	
6. Rooi	
7. Groen	
8. Pers	
9. Weet nie	

E-16: Wat sê die woord "HARMFUL" op die etiket vir jou?

_____

_____

E-17: Op die etiket sê dit: "***Vermy besoedeling van voedsel, voer, drinkwater en eetgerei***".

[WYS NA DIE SIN OP ETIKET 2 BY VOORSRGMAATREëLS].

E-17.1: Wat beteken "vermy besoedeling van voedsel"?

_____

_____

E-17.1(a): Hoe sal u die besoedeling van voedsel "vermy " as u hierdie plaagdoder gebruik?

_____

_____

E-17.2: Wat is "eetgerei"?

_____

_____

E-17.2(a): Hoe sal u die besoedeling van eetgerei "vermy " as u hierdie plaagdoder gebruik?

_____

_____

E – 18: Op hierdie etiket sê dit: **"Gooi waswater weg waar die nie gewasse, weiding, riviere of damme sal besoedel nie"**
[WYS NA DIE SIN OP ETIKET 2 ONDER VOORSORGMAATREËLS]

E – 18.1: Wat beteken "gooi waswater weg" vir u?

_____

_____

E – 18.1(a): Waar sal u waswater "gooi" sodat dit nie gewasse, weiding, riviere of damme besoedel nie?

_____

_____

Instruksie: Oorhandig **die blou etiket** aan respondent: Dithane M-45 800 WP

E-19: Volgens hiedie etiket, watter voorsorgmaatreëls moet u neem wanneer u hierdie plaagdoder gebruik?
MOENIE DIE LYS LEES NIE, MERK DIE ANTWOORDE WAT GENOEM WORD.

	Merk
1. vermy kontak (aanraking) met vel	
2. vermy kontak met oë	
3. vermy kontak met klere	
4. moenie stof of spuit mis in asem nie	
5. dra 'n gesigsmasker en rubber handskoene wanneer u die plaagdoder meng	
6. was gekontamineerde klere	
7. moenie oor water spuit of toelaat dat dit na water beweeg/deurlek nie	
8. vermy kontaminasie van kos, voer, drinkwater en eetgerei	
9. vernietig leë houers deur gate daarin te maak	
10. Ander (spesifiseer)	

E-20: Volgens die etiket, moet jy die plaagdoder houer brand waanner dit leeg is?

1_____ ja
2_____ nee
3 _____ weet nie

Op die etiket, sê dit dat:

"Vernietig die leë houer deur dit te perforeer, plat te trap en te begrawe en moet dit vir geen ander doel gebruik nie."

E -21: Wat beteken "perforeer" daarin maak?

	Merk een
1. nooit die woord voorheen gehoor nie	
2. weet nie	
3. brand	
4. begrawe	
5. plat maak	
6. maak gate daarin	
7. ander (spesifiseer)	

F: Beskermingsgedrag

F – 1: Wat dink u is die moontlike negatiewe gevolge van plaagdoders by die werk vir u en u mede werkers? **(benoem onder; vra altyd "enige iets verder?")**

_____

_____

F – 2: Hoe maklik is dit vir u om moontlike negatiewe gevolge van plaagdoders te voorkom:

- **F – 2.1:** Vir uself by die werk? Sal u sê....**LEES LYS en merk een**

  1 _____ baie maklik
  2 _____ matiglik maklik
  3 _____ glad nie maklik nie

- **F – 2.2:** Vir u mede werkers? Sal u sê....**LEES LYS en merk een**

  1 _____ baie maklik
  2 _____ matiglik maklik
  3 _____ glad nie maklik nie

➢ **F – 2.3:** By die huis? Sal u sê....**LEES LYS en merk een**

1 _____ baie maklik
2 _____ matiglik maklik
3 _____ glad nie maklik nie

F – 3: Doen u enige iets om uself te beskerm teen blootstelling aan plaagdoders?

1 _____ ja **(Indien ja, gaan na F – 3.1)**
2_____ nee

F – 3.1: Indien ja, wat doen u?

_____

_____

F – 4: Gebruik u persoonlike beskermings toerusting (PBT) in u huidige werk?

1_____ ja **(Indien ja, gaan na F-4.1)**
2_____ nee

F – 4.1: Hoe gereeld gebruik u PBT wanneer u werk met plaagdoders?

	Merk een
1. soms	
2. altyd	
3. nooit	

F-4.2: Hoekom dra u PBT?

	Merk
1. Omdat ek gesê was deur die plaas bestuurder/ werkgewer	
2. want ek wil nie siek raak nie	
3. omdat plaagdoders gevaarlik is	
4. omdat die ander werkers PBT dra	
5. Ander (spesifiseer).....	

F-5: Glo u dat PBT u beskerm teen alle mootlike gesondhieds effekte/nagevolge van plaagdoders?

1_____ ja
2 _____ nee
3 _____weet nie

G. VERGIFTIGINGS GEBEURE

G – 1: Het u al ooit siek geword toe u met plaagdoders gewerk het?

1 _____ ja
2 _____ nee
3 _____ weet nie

G – 2: Wat beteken dit om "vergiftig te wees deur plaagdoders"?

_____
_____

G – 3: Was u al ooit vergiftig deur plaagdoders?

1 _____ ja **(Indien ja, gaan an G – 3.1)**
2 _____ nee **(Indien nee, gaan na G –4)**
3 _____ weet nie

G – 3.1 Hoe dink u was u vergiftig?

_____
_____

G – 3.2: Het u na 'n dokter of kliniek gegaan?

1 _____ ja
2 _____ nee

G – 3.3: Het u aangehou werk toe u siek was?

1 _____ ja
2 _____ nee

G-4: Was enige een met wie u gewerk het al vergiftig?

1 _____ ja
2 _____ nee

G-5: Was enige van u familielede al ooit vergiftig?

1 _____ ja
2 _____ nee

Dankie dat u die tyd geneem het om die vrae vir my te antwoord. Hier is 'n kaartjie wat aan u vertel wat sommige van die prente en kleure op plaagdoder etikette beteken. Gebruik asseblief die kaartjie om u te help om die plaagdoder etikette vir alle plaagdoders wat u in u werk en huis gebruik te verstaan.

APPENDIX C

Dow AgroSciences

AZINPHOS-METHYL 350 WP

LABEL

Reg No L3960 Wet/Act 36/1947

A wettable powder contact and stomach insecticide for the control of certain species of insects and mites (as listed) on citrus, deciduous fruit, cotton, potatoes and olives.

'n Benatbare poeier kontak- en maaginsekdoder vir die beheer van sekere insek- en mytplae (soos aangedui) op sitrus, sagtevrugte, katoen, aartappels en olywe.

AKTIEWE BESTANDDEEL / ACTIVE INGREDIENT

Azinphos-methyl.....350
g/kg.....Asinfosmetiel
(organophosphate) (organofosfaat)

Net Mass ..... kg.....Netto Massa

REGISTRATION HOLDER / REGISTRASIEHOUER
DOW AGROSCIENCES SOUTHERN AFRICA (PTY) LTD / (EDMS) BPK
REG NO 1967/007147/07
PRIVATE BAG X 55 PRIVAATSAK
BRYANSTON 2021

Batch Number . . . . Lotnommer

Date of Manufacture . . . .Vervaardigingsdatum

UN NUMBER: 2783
24 Hour Emergency Tel No: (032) 533-0716
Information Hotline Tel No: (012) 842-0200



WARNINGS

The following number of days must be allowed between last application and harvest of the crop:

Peaches for canning ..... 3 days
Cotton ..... 5 days
Apples and pears.....14 days
Peaches in summer rainfall area .....21 days
Citrus .....21 days
(when Parathion is added do not apply later than 6 weeks after petal drop)
Potatoes .....21 days
Peaches, plums, apricots .....28 days

Cotton for grazing .....35 days
Olives .....90 days

Handle with extreme care. Poisonous when absorbed through the skin, swallowed or inhaled. Toxic to fish, bees and wild life. Store under lock and key in a cool place. Store away from food and fodder. Keep out of reach of children, pets and uninformed persons. In case of poisoning, call a doctor and make this label available to him.

AERIAL APPLICATION: Notify all inhabitants of the area to be sprayed and issue the necessary warnings. Do not spray over or allow drift to contaminate water of adjacent areas.

Although this remedy has been extensively tested under a large variety of conditions the registration holder does not warrant that it will be efficacious under all conditions because the action and effect thereof may be affected by factors such as abnormal climatic and storage conditions; quality of dilution water; compatibility with other substances not indicated on the label and the occurrence of resistance of the pest against the remedy concerned as well as by the method, time and accuracy of application. The registration holder furthermore does not accept responsibility for damage to drops, vegetation, the environment or harm to man or animal or for lack of performance of the remedy concerned due to failure of the user to follow the label instructions or to the occurrence of conditions which could not have been foreseen in terms of the registration. Consult the supplier or registration holder in the event of any uncertainty.

PRECAUTIONS

Do not inhale spray mist. Wear full protective clothing (overall, rubber boots, gloves and suitable respirator). Wash contaminated clothing daily. Wash with soap and water after use or accidental skin contact. Do not eat, drink or smoke whilst mixing, applying or before washing hands and face. Avoid drift or spray onto other crops, grazing, rivers and dams and areas not under treatment. Prevent contamination of food, feed, drinking water and eating utensils.
Clean sprayer before using for other remedies and dispose of wash water where it will not contaminate crops, grazing, rivers and dams.

Containers and packages must be completely emptied before being disposed of. Shake out thoroughly into the mixing or spray tank. Thereafter rinse the container three times with a volume of water equal to a minimum of 10% of that of the container. Add the rinsings to the contents of the spray tank before destroying the container in the prescribed manner. Destroy empty container by perforation and flattening and never use for any other purpose.

SYMPTOMS OF HUMAN POISONING

Headache, fatigue, faintness, giddiness, excessive sweating, nausea, abdominal pains, vomiting, diarrhoea, tightness of chest, anxiety, blurred vision, muscle twitching beginning in eyelids tongue, small pupils, respiratory distress, convulsions, coma.

FIRST AID TREATMENT

Remove patient from source of poisoning and keep him quiet and reassured. Remove contaminated clothing and rinse contaminated area thoroughly with plenty of soap and cold water. Do not rub skin hard. Flush contamination out of eyes with clean water for 15 minutes. If swallowed, induce vomiting by tickling back part of throat. Repeat until vomit fluid is clear and free from smell of poison. Administer artificial respiration or closed chest cardiac massage if necessary. Do not apply direct mouth to mouth respiration. Never give anything by mouth to an unconscious person. Take the patient immediately to the nearest physician

NOTE TO PHYSICIAN

Administer atropine sulphate intravenously (1 to 4 mg) every 5 to 10 minutes until signs of atropinization (dry flushed skin and tachycardia) occur. 2 PAM 50 mg/kg up to total dose of 1 to 2 g or 2/3 of this dose of Protopam. Repeat oximes if necessary. Do not give morphine.

DIRECTIONS FOR USE: USE ONLY AS DIRECTED

COMPATIBILITY: Compatible with most insecticides and fungicides but not with Lime Sulphur, Bordeaux Mixture or other alkaline chemicals.

MIXING INSTRUCTIONS: First mix the required quantity with some water in the spray tank. Keep the agitator running whilst the remainder of water is added to the pre-mix. Keep tank mixture agitated during application. Spraying should be done on dry, calm days and on the same day than mixing. Plants must be wetted thoroughly.

RESISTANCE MANAGEMENT FOR CODLING MOTH ON APPLES AND PEARS:

Apply a maximum of four (4) applications of **AZINPHOS-METHYL 350 WP**, to only one generation per season. Use Mating Disruption and/or non-related insecticides supplementary to the program.

APPLICATION RATES

CROP AND PEST	DOSAGE	REMARKS
APPLES, PEARS, PEACHES AND APRICOTS Codling moth	50 g per 100 ℓ water	Commence applications with the onset of a generation and apply as a full cover spray. Repeat applications at intervals of 14 days. NOTE: Applications against Codling moth will also control leaf rollers and pear bud mite.
APPLES, PEARS, PEACHES, PLUMS AND APRICOTS Bryobia Mite	50 g per 100 ℓ water	Apply as a full cover spray and repeat if necessary.
CITRUS Soft brown scale and Aphids	70 g per 100 ℓ water	Apply as a corrective spray when pest is noticed.

CROP AND PEST	DOSAGE	REMARKS
POTATOES Tuber moth	700 g per ha	**Tractor and aerial application:** Commence spraying when plants are approximately one month old, at first signs of infestation and repeat at intervals of not more than 14 days.
COTTON Red bollworm, Aphids and Stainers	350 g per 100 ℓ water 700 to 1 000 g per hectare	**Tractor application:** Commence spraying at first signs of infestation and repeat at weekly intervals and after rain. Depending on plant size, apply up to 300 ℓ spray mixture per ha. **Aerial application:** Increase the rate of application and preferably also the volume of spray per ha according to the growth of the plants. Regular weekly applications will suppress red spider mite.
OLIVES Leafeating beetles and suppression of Scale insects	70 g per 100 ℓ water	Apply as a full cover corrective spray during November and repeat as required.
LATE PEACHES (Summer rainfall area) False Codling moth	70 g per 100 ℓ water	**Early cultivars:** Apply as full cover spray 5 and 3 weeks before harvest. **Late cultivars:** Apply as a full cover spray 7, 5 and 3 weeks before harvest. Do not apply to fruit destined for export.

CROP AND PEST	DOSAGE	REMARKS
PEACHES (also non-bearing and nursery trees) Suppression of Oriental fruit moth	70 to 140 g per 100 ℓ water	Apply one or more of the following sprays with a maximum of 4 sprays per season. **Spray I**: Apply 140 g/100 ℓ water 278 to 333 degree days (*) after the start of the first sustained trap catches of the season (bio-fix). Monitor traps daily until biofix and weekly thereafter. **Spray II**: Apply 140 g/100 ℓ water 278 to 333 degree days (*) after the start of the second moth flight of the season. **Spray III and IV**: Apply 70 g per 100 ℓ water 278 to 333 degree days (*) after the third and fourth moth flights of the season. Should any of the above applications coincide with the recommended spray times for false Codling moth simul-taneous control of false Codling moth will be achieved. If the application(s) do not coincide, products other than Azinphos-methyl be used. Under no circumstances may more than four Azinphos-methyl sprays be applied per season. The last application before harvest must not exceed 70 g per 100 litre water. Not to be used on nectarines.

(*) Information on spray dates for the different production areas will be determined on the basis of the date of first Oriental fruit moth emergence (biofix) in those areas and disseminated to growers.

24 HOUR EMERGENCY TEL. NO. (032) 533-0716

INFORMATION HOTLINE : TEL. NO.: (012) 842-0200

To view this label in Afrikaans, please contact the author at: andrea@cormack.uct.ac.za

APPENDIX D

READ ENTIRE LABEL	GROUP D HERBICIDE

GRAMOXONE

LABEL

Reg. No. L1174 : Act 36 / 1947
N - AR 0186 : (NAMIBIA)

An aqueous solution contact herbicide for the control of annual grasses and annual broadleaf weeds in crops as listed and as a sugar-cane desiccant. Inactivated on contact with the soil.

ACTIVE INGREDIENT:

paraquat ion (bipyridyl) .....200 g / ℓ.
(as dichloride salt) .....276 g / ℓ.

ℓ

Registration holder:
Syngenta South Africa (Pty) Ltd.
Co. Reg. No. 98 / 13761 / 07
Private Bag X 60
HALFWAY HOUSE 1685
RSA.

© SYNGENTA AG, 2001
Batch No.
Date of manufacture.

Emergency Tel. No. 0860 333 911. Bateleur 911.



WARNINGS:

* **Withholding periods:** (Minimum number of days between last application and feeding) :

  Sugar-cane (feeding) and grazing.....
  .....21 days.

* Handle with care.
* Harmful if swallowed.
* Undiluted **GRAMOXONE** can cause eye and skin irritation.
* Keep locked up out of reach of children, uninformed persons and animals.
* Store away from food, feed, fertiliser and seed.
* Keep animals out of treated area until the spray has dried.
* **Aerial application: (seedbed preparation and sugar-cane desiccation only).** Notify all inhabitants in the immediate vicinity of the area to be sprayed and issue the necessary warnings. Do not spray over or allow drift to contaminate water or adjacent areas. **Avoid drift onto adjacent crops as green plant tissue will be damaged by the spray**.

- **General warning:**

Although this remedy has been extensively tested under a large variety of conditions, the registration holder does not warrant that it will be efficacious under all conditions because the action and effect thereof may be affected by factors such as abnormal soil, climatic and storage conditions; quality of dilution water, compatibility with other substances not indicated on the label and the occurrence of resistance of the weed against the remedy concerned, as well as by the method, time and accuracy of application. The registration holder furthermore does not accept responsibility for damage to crops, vegetation, the environment, or harm to man or animal or for lack of performance of the remedy concerned due to failure of the user to follow the label instructions or to the occurrence of conditions which could not have been foreseen in terms of the registration. Consult the supplier in the event of any uncertainty.

PRECAUTIONS:

- Do not eat, drink or smoke while handling this product.
- Avoid contamination of food, feed, drinking water and eating utensils.
- Do not use application equipment or spray pressures which result in the formation of a fine spray mist ie mistblowers, ULV applicators and other similar equipment.
- Do not use muddy water.
- With knapsack and hand-held sprayers, mix each 1 part of **GRAMOXONE** with at least 40 parts of water.
- Wear rubber gloves and face shield when handling the concentrate. If you get it in your eyes, flush it out at once. If you get it on your skin, wash it off at once. If you spill it on your clothes, change and wash them. (**See first aid**).
- Invert the empty container over the spray or mixing tank and allow to drain for at least 30 seconds after the flow has slowed down to a drip. Thereafter rinse the container three times with a volume of water equal to a minimum of 10 % of that of the container. Add the rinsings to the contents of the spray tank before destroying the container.
- Wear rubber gloves and face shield while spraying. Do not inhale the spray mist and avoid contact with the spray as much as you can. Avoid spray drift onto other crops, grazing rivers or dams.
- Wash equipment after use with 30 mℓ **AGRAL 90** / 50 ℓ water. Do not use the empty container for any other purpose. Crush or cut it then burn or bury it. Keep unused **GRAMOXONE** in this container, tightly closed, away from food. Dispose of wash water where it will not contaminate crops, grazing, rivers or dams.
  Change and wash your work clothes.
  Wash yourself.

First Aid:

Eye splashes : flush eyes for 10 - 15 minutes with clean water. Consult a doctor. **IF GRAMOXONE IS SWALLOWED** make the person vomit. Immediately take person, and this container and label to hospital for emergency medical treatment.

Emergency Medical Treatment:

Give 1,0 ℓ suspension of Fuller's Earth (15 %) or Bentonite (7 %) or activated charcoal. Also give purgative e.g. Mannitol (20 % solution). See booklet "Treatment of Paraquat poisoning" (available from **GRAMOXONE** distributors).

DIRECTIONS FOR USE: Use only as indicated.

Compatibility:

GRAMOXONE is compatible with **GALLEON** (L 4323), **IMPI** (L 4368), **REGLONE** (L 1115), **RELAY** (L 3898), **SPRINT** (L 4896), **WENNER** (L 3895) and most other registered herbicides. If **GRAMOXONE** needs to be used in tank-mix combinations with other herbicides, first mix small quantities of the chemicals in the same ratio in which they will be used, separately with water. Add these mixtures together while agitating and check for any signs of incompatibility e.g. flocculation, etc. In this instance, full cognisance must be taken of all warnings, precautions and directions for use mentioned on the labels of the products concerned.

Mixing instructions:

Mix the required quantity of **GRAMOXONE** with **clean** water in the spray tank.
When **GRAMOXONE** is used in a tank mixture with another herbicide(s) follow the mixing instructions on that label. Continuous agitation is essential when applying tank mixtures.

A. **Use as a Herbicide:**

GRAMOXONE is a contact herbicide and should only be applied to weeds in the early growth stages for optimum control. **AVOID** spraying large established weeds since the control will not be satisfactorily and more than one application may be needed. Re-growth may also occur under these conditions.

Apply by ground sprayers or by knapsack sprayer. USE HIGH VOLUME AND HIGH DOSAGE RATE FOR SPRAYING DENSE WEED GROWTH. Ensure thorough coverage of the weeds. Do not spray buds or green parts of any crop. **GRAMOXONE** kills green tissue but does not harm brown mature bark.

CROP	DOSAGE / ha	REMARKS
A. TREE CROPS. Deciduous fruit orchards. e.g. Apples. Pears, etc.	1,25 - 5,0 ℓ	Apply in 200 - 750 ℓ water / ha as necessary in spring. Mix with simazine for residual effect. **(in pome fruit only).** Where Cape marigold is present, replace half **GRAMOXONE** with **REGLONE.** (Refer to **REGLONE** label). Add **AGRAL 90** (L 5279) at 50 mℓ / 100 ℓ spray mixture.
	1,5 - 2,5 ℓ **GRAMOXONE** plus 5,0 ℓ MCPA.	Apply in 200 - 750 ℓ water / ha for the control of ribwort (*Plantago* spp), *Convolvulus* spp as well as annual winter grasses.

CROP	DOSAGE / ha	REMARKS
Subtropical fruit and nut orchards. e.g. Bananas, tea, coffee, citrus, avocados, papayas, pecans, macadamias, etc.	1,25 - 5,0 ℓ	Apply in 200 - 750 ℓ water / ha using a low pressure floodjet nozzle. Add **AGRAL 90** at 50 mℓ / 100 ℓ spray mixture. **In citrus only:** can be mixed with a suitable registered residual herbicide. Add **AGRAL 90** at 50 mℓ / 100 ℓ spray mixture.
Vineyards	1,25 - 5,0 ℓ	Apply in 200 - 750 ℓ water / ha as an overall application before bud burst. Subsequently as a directed spray. Where Cape marigold is present, replace half the **GRAMOXONE** with **REGLONE**. (Refer to **REGLONE** label). Add **AGRAL 90** at 50 mℓ / 100 ℓ spray mixture. For longer residual control add Simazine at the registered rate.
	1,5 - 2,5 ℓ **GRAMOXONE** plus 5,0 ℓ MCPA	Apply in 200 - 750 ℓ water / ha to control ribwort (*Plantago* spp) and *Convolvulus* spp as well as annual winter grasses.
B. ROW CROPS.		
Maize Post-emergence weed control during the fallow period i.e. between harvest and planting	1,25 - 5,0 ℓ	Apply in 200 - 500 ℓ water / ha. The dosage rate will depend on weed size and density. Where the control of well established winter weeds is required apply 2 - 3 ℓ **2,4-D** / ha followed by 2 - 3 ℓ **GRAMOXONE** / ha 3 to 4 weeks later. Always add **AGRAL 90** to the **2,4-D** and **GRAMOXONE** at the rate of 200 mℓ / 100 ℓ spray mixture.
Inter-row weed	1,25 - 5,0 ℓ	Apply in 200 - 300 ℓ water / ha as a low pressure directed spray to weeds not taller than 10 cm. Use

CROP	DOSAGE / ha	REMARKS
control	For residual weed control use 1 - 2 ℓ **GRAMOXONE** plus a suitable registered residual herbicide.	"flood-jet" or "LP" nozzles with drop arms or drop legs. **Maize plants must be at least 30 cm tall. Do not apply to maize under stress or maize with a low yield potential or during windy conditions or to fields with uneven surfaces.** **IMPORTANT:** Consult all the label(s) of the product(s) in the mixture with **GRAMOXONE** for directions for use, safety precautions, rates, use restrictions, mixing instructions and weeds controlled. Always add a suitable surfactant such as **AGRAL 90** at 200 mℓ / 100 ℓ spray mixture. **NOTE:** Scorch of the lower leaves of the maize plant will occur. Care must be taken to avoid spray contact with more than the 2 lower leaves as more damage to the maize plant may result in yield reduction.
Potatoes. Weed control (early post-emergence)	1,25 - 5,0 ℓ	Apply in 300 - 500 ℓ water / ha. For residual grass control, spray lands with a mixture of 1,0 ℓ **GRAMOXONE** plus **WENNER** or **RELAY** at the registered rates before the crop has reached 10 % emergence.
Cassava. Post-emergence weed control.	1,25 - 5,0 ℓ For residual weed control use 1,5 - 2,0 ℓ **GRAMOXONE** plus a suitable registered residual herbicide.	Apply as a directed spray after plants have shed leaves. The dosage depends on the growth stages of the weeds.
Vegetables .	1,25 - 5,0 ℓ	Apply in 200 - 500 ℓ water / ha as a directed inter-row spray for all row crops where weeds have already germinated but are not bigger than 10 cm **OR** use a knapsack sprayer fitted with a shield. Add **AGRAL 90** at 50 mℓ / 100 ℓ spray mixture (2,5 mℓ / 5 ℓ water).
Sugar-cane. (Directed post-emergence in plant and	1,25 - 5,0 ℓ For residual weed control use 0,5 - 3 ℓ	The dosage will depend on weed size and density. **IMPORTANT:** Consult all the label(s) of the product(s) in the mixture with **GRAMOXONE** for safety precautions, rates, mixing instructions and weeds controlled.

CROP	DOSAGE / ha	REMARKS
ratoon).	**GRAMOXONE** plus a suitable registered residual herbicide.	
Wheat. Post-emergence weed control during the fallow period ie. between harvest and planting	1,25 - 5,0 ℓ	Apply in 200 - 500 ℓ water / ha before planting. Where Cape marigold (*Arctotheca calendula*) is present half the **GRAMOXONE** should be replaced by **REGLONE**. (Refer to **REGLONE** label). Add **AGRAL 90** at 50 mℓ / 100 ℓ spray mixture.
Hops	1,25 - 5,0 ℓ	Apply in 200 - 500 ℓ water plus 50 mℓ **AGRAL 90** / 100 ℓ spray mixture as an overall application or on plant rows to control young annual grasses and broadleaf weeds. Apply prior to the emergence of first year cuttings. **GRAMOXONE** can be used together with recommended registered pre-emergence herbicides. In established hop plants **GRAMOXONE** can be used to control young weeds and can also be used as a burn-down agent in mature hops during winter but not later than September.
	3,0 - 5,0 ℓ	Apply in 200 - 500 ℓ water plus 50 mℓ **AGRAL 90** / 100 ℓ spray mixture to control annual grasses and broadleaf weeds between plant rows and / or on plant rows when the hop plants are in a dormant stage. Can be applied together with other registered pre-emergence herbicides.
C. NON ROW CROPS. Lucerne (over 6	1,25 - 5,0 ℓ	Apply in 300 ℓ water / ha just before dormancy breaks or after harvesting before re-growth of lucerne occurs.

CROP	DOSAGE / ha	REMARKS
months old)		
D. OTHER USES. **Industrial areas.**	2,5 - 5,0 ℓ	Apply in 500 - 1 000 ℓ water / ha. Use high spray volume and high dosage rates for dense weeds.
Potatoes Haulm killing.	2,5 - 5,0 ℓ	Apply in 500 - 1000 ℓ water / ha. Do not apply if haulms show signs of wilting as tuber damage may occur.
Sugar-cane. Desiccation.	2,0 - 3,0 ℓ	Apply in 100 ℓ water / ha. Burn cane as soon as practical after treatment. **Aerial application:** Apply in 30 ℓ water / ha.

NB: Avoid drift onto adjacent crops as green plant tissue will be damaged by the spray.

WEEDS WHICH ARE CONTROLLED BY GRAMOXONE:

Most annual weeds that have already germinated.

WEEDS MENTIONED BELOW WILL ONLY BE CONTROLLED TEMPORARILY:

Perennial weeds, volunteer maize and Domonia weed.

Relay, Sprint and Wenner are the registered trade marks of Dow AgroSciences Southern Africa (Pty) Ltd.

Gramoxone®, Agral®, Galleon® and Reglone® = registered trade marks of a Syngenta Group Company.

To view this label in Afrikaans, please contact the author at: andrea@cormack.uct.ac.za

APPENDIX E

Dow AgroSciences

DITHANE M-45 800 WP

LABEL

Reg No L2914 Act/Wet 36/1947

An organic fungicide recommended for the prevention and control of a number of fungus diseases on various crops as listed below.

'n Organiese swamdoder vir die voorkoming en beheer van 'n aantal verskillende swamsiektes op gewasse soos hieronder aangedui.

FUNGICIDE GROUP Y SWAMDODERGROEP

ACTIVE INGREDIENT/AKTIEWE BESTANDDEEL

Mancozeb (dithiocarbamate) ..... 800 g/kg ..... Mankoseb (ditiokarbamaat)

Net Contents .....25 kg .....Netto Inhoud

REGISTRATION HOLDER / REGISTRASIEHOUER
DOW AGROSCIENCES SOUTHERN AFRICA (PTY) LTD / (EDMS) BPK
REG NO 1967/007147/07
PRIVATE BAG X 55 PRIVAATSAK
BRYANSTON 2021

Batch Number . . . . . .Lotnommer

Net Contents . . . . . .Vervaardigingsdatum

Expiry date . . . . . .Vervaldatum

UN NUMBER: 3077
24 Hour Emergency Tel No: (032) 533-0716
Information Hotline Tel No: (012) 842-0200



WARNINGS

If **DITHANE M-45 800 WP** is used on harvest and fodder crops, the following waiting periods must be observed:

Table grapes..... 4 to 6 weeks
Groundnut foliage to be used as fodder..... 21 days
Tomatoes, beans, peas and cucurbits..... 3 days

All other edible crops..... 14 days

THE RECOMMENDED WITHHOLDING PERIOD BETWEEN LAST APPLICATION AND HARVEST MEETS LOCAL RESIDUE LEVEL REQUIREMENTS, BUT MAY NOT MEET EXPORT REQUIREMENTS.

May cause irritation of the skin, eyes and air passages.
Toxic to fish.
Keep out of reach of children, uninformed persons and animals.
Keep the container well closed when not in use.
Store in a cool, dry place, away form food or feedstuffs.

If the chemical is allowed to get damp and then warmed up, it may generate flammable vapours and should therefore be kept away from sparks and open flames.
DO NOT USE **DITHANE M-45 800 WP** ON TOBACCO SEEDLINGS

AERIAL APPLICATION: Notify all inhabitants of the immediate area to be sprayed and issue the necessary warnings. Avoid overlapping of applications and drift to contaminate water or adjacent areas.

Although this remedy has been extensively tested under a large variety of conditions the registration holder does not warrant that it will be efficacious under all conditions because the action and effect thereof may be affected by factors such as abnormal soil, climatic and storage conditions; quality of dilution water; compatibility with other substances not indicated on the label and the occurrence of resistance of the disease against the remedy concerned as well as by the method, time and accuracy of application. The registration holder furthermore does not accept responsibility for damage to crops, vegetation, the environment or harm to man or animal or for lack of performance of the remedy concerned due to failure of the user to follow the label instructions or to the occurrence of conditions which could not have been foreseen in terms of the registration.

Consult the supplier or registration holder in the event of any uncertainty.

PRECAUTIONS

Avoid contact with the skin, eyes and clothes, as well as inhalation of dust and spray mist.
Wear face mask and rubber gloves when mixing product.
Wash thoroughly with soap and water after application and in case of eye contamination, rinse the eyes thoroughly with plenty of cold water and obtain medical aid if necessary.
Wash contaminated clothing.
Do not spray over water or allow spray drift onto water or adjacent areas not under treatment.
Prevent contamination of food, feeds, drinking water and eating utensils.
Containers and packages must be completely emptied before being disposed of. Shake out thoroughly into the mixing or spray tank before destroying the empty container.
Destroy empty container by perforation and flattening and never use for any other purpose.
Do not burn the empty container.

DIRECTIONS FOR USE : Use only as directed

COMPATIBILITY

DITHANE M-45 800 WP is compatible with most fungicides and insecticides, but should not be used with alkaline products, e.g. LIME SULPHUR and BORDEAUX MIXTURES. Do not use **DITHANE M-45 800 WP** together with CALCIUM ARSENATE or UREA on citrus.

MIXING INSTRUCTIONS

First fill the spray tank half with water. Mix recommended quantity of **DITHANE M-45 800 WP** in a little water into a slurry, add more water, stir well and add to the spray tank whilst filling with the bulk of water. When used with emulsifiable concentrates it is essential that the **DITHANE M-45 800 WP** be properly creamed in a little water before adding to the spray tank. The tank should then be topped up with water and the contents well agitated before the emulsifiable concentrate is added. Maintain agitation of spray tank contents throughout spraying operation.

APPLICATION DIRECTIONS

Note: **DITHANE M-45 800 WP** is a preventative contact fungicide and should be applied before expected infection periods, or in regular programmes.

Deciduous Fruits: **DITHANE M-45 800 WP** can also be applied as a Low Volume (LV) application.
Rate per ha should be calculated according to the formula for "*High Volume Requirement*" (HVR), using "*Unrath's formula*" for "*Tree Row Volume*" (TRV)

$$TRV \times 937 = \frac{\text{Tree Height (TH)* x Tree Width (TW)* x 937}}{\text{Distance between Rows (RW)}} = \text{HVR in liters per ha}$$

**(Tree height and tree width should be measured during summer when trees are at full flush)*

Directions for Application Volumes (AV) at different growth stages and the calculation of rate per ha, based on High Volume Requirements (HVR)

Bud Break to Full Blossom: AV = 60 % x HVR
75 % Petal Fall to One month later (Mid Season): AV = 80 % x HVR
Mid Season to Post Harvest, Before Leaf Drop: AV = 100 % x HVR

$$\textbf{Rate per ha} = \frac{\text{(HVR) liters per ha x Rate per 100}}{100}$$

Note: Application of **DITHANE M-45 800 WP** should be made **before** overhead irrigation.

On apples and pears, application can also take place in the form of a low volume (LV) treatments. Instructions for this use are given at the bottom of the table below – **follow these instructions carefully**.

APPLICATION RATES

CROP AND DISEASE	RATE	REMARKS
POTATOES Early and Late Blight		Application of **DITHANE M-45 800 WP** can be done in Low- or High Volume
	200 – 300 g/100 ℓ water	**High Volume:** Commence application after emergence of crop at 500 ℓ spray mixture/ha. Increase spray volume up to 1000 ℓ/ha as plant foliage increase.
	2 – 3 kg/ha	**Low Volume:** Use only suitable equipment and apply in 200 – 300 ℓ water/ha. **Aerial Application:** Apply in 30 ℓ water/ha. Use the higher rate from 6 weeks after emergence or when conditions are favourable for disease development. Repeat application every 7 - 10 days or after rain.
Fusarium, Dry Rot and Common Scab	300 g/100 ℓ water	For seed potatoes only: Dip the whole or cut tubers in the suspension. Let tubers dry off and store under cool and well aerated conditions in disease free mass containers. Change dipping suspension frequently especially if the potatoes have a film of soil.

CROP AND DISEASE	RATE	REMARKS
APRICOTS, PEACHES AND PLUMS Rust	H.V 150 g/100 ℓ water (2,25 - 4,5 kg/ha). L.V 1,8 - 3,6 kg/ha in 1/4 to 1/8 of high volume spray mixture per ha.	**Winter Rainfall Region:** Start applications early in November. **Summer Rainfall Region:** Apply from mid-February. Repeat at 10 - 14 day intervals as necessary.
Gumspot	H.V 150 g/100 ℓ water (1,8 - 3,75 kg/ha) L.V 1,25 - 3,0 kg/ha	1. Autumn: Just after harvest. 2. Autumn: 75 % leaf drop. 3. Spring: Copper spray at bud movement. 4. Spring: 80 % petal fall. 5 & 6. Two further applications at 14 days intervals if necessary. For plums commence spraying from mid-December and apply 2 sprays at 10 day intervals.
APRICOTS AND PEACHES Freckle Apricots and Peaches	H.V 150 g/100 ℓ water (2,25 - 3,75 kg/ha) L.V 1,8 - 3,0 kg/ha	**Winter Rainfall Region:** Apply at 75 - 100 % petal drop and repeat 14 days later. In wet seasons repeat application monthly on late cultivars. **Summer Rainfall Region:** First application 3 weeks after petal drop and again 14 days later. In wet seasons repeat application monthly on late cultivars.
NOTE: Do not apply more than six applications of **DITHANE M-45 800 WP** during the period that the fruit is on the tree.		

CROP AND DISEASE	RATE	REMARKS
YOUNG- AND BOYSENBERRIES Downy Mildew and Anthracnose	200 g/100 ℓ water 1 - 4 kg/ha	**Anthracnose:** Commence spraying as soon as the first flowers appear and repeat every 7 -10 days. **Downy Mildew:** Commence spraying when first signs of disease are noticed. Repeat every 10 – 14 days until risk for regular rains diminished. Apply adequate water to ensure thorough wetting of plant foliage (500 – 2000 ℓ spray mixture/ha, depending on plant density and plant foliage at the time of application).
APPLES AND PEARS Scab and Septoria Leaf Spot	150 g/100 ℓ water (30 - 5,25 kg/ha) High volume application only (2000 - 3500 ℓ spray mixture/ha)	May be applied as both pre- and post-blossom sprays.
	Pre-blossom	Apply 3 times with the first application when the trees reach green tip stage and the last prior to blossoming.
	Post-blossom	Apply immediately after blossoming and repeat 4 - 6 times at 7 - 14 days intervals. Use the lower spray volume for the pre-blossom and first 1 or 2 post blossom sprays and the higher spray volume for all subsequent applications.
	500 g/100 ℓ water (2 - 4 kg/ha) Low volume application only (500 - 900 ℓ spray	Apply immediately after blossoming and repeat 4 - 6 times with 7 - 14 day intervals. Use the lower spray volume for the first one or two post-

	mixture/ha)	blossom applications and the high volume for all subsequent applications.

NOTE: 200 gram **DITHANE M-45 800 WP** IN 100 ℓ water = 30 grams/15 ℓ water.
(2 lb. In 100 gal. Water = 1 oz. In 3 gal. Water)
30 gram (1 0z.) = 3 level tablespoons of aerated powder.

CROP AND DISEASE	RATE	REMARKS
APPLES AND PEARS (cont.) Scab and Septoria Leaf Spot		**DITHANE M-45 800 WP** is compatible with most systemic fungicides registered for the treatment of scab. (See labels of such products to be used).
QUINCES Black spot	125 g/100 ℓ water	Commence applications at green tip stage. Repeat at weekly intervals till 75 % petal drop and repeat thereafter at 10 – 14 day intervals until the risk for regular rain diminished.
GRAPE VINES Downy mildew (*Phomopsis viticola*)	Pre-blossom: 200 g/100 ℓ water OR 1 - 1,5 kg/ha	Apply first spray when young shoots have reached a length of 10 cm. Further sprays depending upon weather conditions, should be applied at 7 - 10 day intervals. During this period use 500 - 700 ℓ (high volume) spray mixture per ha.
	Blossom - 80 % Calyx fall: 200 g/ 100 ℓ water OR 1,5 - 2 kg/ha	Application necessary only if the blossoming period is longer than 14 days. Apply 750 - 1000 ℓ spray mixture/ha.
	Post-blossom: 200 g/100 ℓ water OR 2 - 3 kg/ha	Apply 2 more applications at 7 - 14 day intervals depending on weather. Apply 1000 - 1500 ℓ spray mixture/ha.

Dead Arm Disease (*Phomopsis viticola*)	200 g/100 ℓ water OR 1 - 1,5 kg/ha	Apply the first treatment when the shoots reach a length of 0,5 to 1 cm. Apply 3 times at intervals of 7 - 10 days prior to blossoming. Use 500 to 700 ℓ spray mixture/ha (high volume). NOTE: Application of **DITHANE M-45 800 WP** should be made before overhead irrigation.

CROP AND DISEASE	**RATE**	**REMARKS**
TOMATOES Early and Late Blight and Septoria Leaf Spot	200 g/100 ℓ water	Use 500 ℓ spray mixture per ha shortly after transplanting and increase the volume of spray mixture to 3 000 ℓ per ha as the plants grow bigger. **NOTE: DITHANE M-45 800 WP** can also be used on seedling tomatoes.
GROUNDNUTS Cercospora and Phyllosticta Leaf Spot	Dryland: 400 g/100 ℓ water Irrigated lands: 300 g/100 ℓ water	Use 400 to 500 ℓ of spray mixture per ha. Commence spraying at the very first signs of disease appearing at the base of the plant and apply 5 sprays at 14 day intervals. Use 1 000 ℓ of spray mixture/ha. Commence spraying at the very first signs of disease appearing at the base of the plant and apply 5 sprays at 14 day intervals.
MANGOES Anthracnose	200 g/100 ℓ water	Apply first spray when panicles appear but before flowers open. Apply second spray at fruit set and thereafter repeat at 14 to

		14 to 21 day intervals.
BANANAS Sigatoka Disease	2,5 kg/100 ℓ water plus 4 to 5 ℓ light/medium mineral oil	Apply as a low volume application. First spray towards the end of November and repeat every 26 days until after rainy season.

CROP AND DISEASE	RATE	REMARKS
CITRUS Black Spot and Melanose	(a) 200 g/100 ℓ water	When rainfall is normal during July to September, spray during the third week of October and repeat 3 times at 25 day intervals
	(b) 200 g/100 ℓ water in the first 2 sprays, then 150 g/ 100 ℓ water plus 600 ml light/ medium mineral oil in subsequent 2 or 3 sprays	<u>or</u> When rainfall is above normal in July to September, apply after full petal drop and repeat 4 times with 25 days intervals.
Citrus Rust Mite	75 g/100 ℓ water	Apply in Spring. The **DITHANE M-45 800 WP** programme against black spot will also control rust mite.
Citrus silver Mite	200 g/100 ℓ water	This pest can cause russetting of lemons and grapefruit during the 5-7 week period after petal fall. Apply to wet the foliage canopy and fruitlets as soon as first mite presence is noticed. Alternatively apply at petal fall to trees which suffered fruit russet the previous season. In the case of lemons, fruitlets resulting form summer blossom are most susceptible to attack.

GUAVAS Lump Disease and Blossom-End Rot	200 g/100 ℓ water	Full cover application in the early stages until fruit begins to swell. Apply at 30 day intervals to protect against lumpy disease. Full cover application 14 days before harvesting when very wet weather is experienced for protection against blossom-end rot.

CROP AND DISEASE	RATE	REMARKS
CUCURBITS Anthracnose and Downy Mildew	200 g/100 ℓ water	Start at first signs of disease. Ensure that the lower leaf surfaces are thoroughly wetted. Use 1 000 to 1 500 ℓ of spray mixture/ha.
BEANS Anthracnose and Rust	1 to 4 kg/ha	Commence spraying at the first signs of disease appearing and repeat at 7 to 10 day intervals. For Anthracnose commence spraying when first flowers appear. Dosage depends on plant density and size. Use enough water to ensure thorough wetting. For aerial application use in 30 ℓ water/ha.
PEAS Downy Mildew	1 to 4 kg/ha	Commence spraying at 4-6 leaf stage or when disease is noted and repeat at 7 to 10 day intervals. Dosage depends on plant density and size. Use enough water to ensure thorough wetting. For aerial application use in 30 ℓ water/ha.

ONIONS Downy Mildew	1 to 4 kg/ha	Commence spraying at 4 to 6 leaf stage or when disease is noted and repeat at 7 to 10 day intervals. Add a wetter/spreader to the spray mixture. Dosage depends on plant density and size. Use enough water to wet the plants thoroughly.
OLIVES Anthracnose	200 g/100 ℓ water	First application in Autumn before discoloration of fruit begins. Repeat 2 to 3 times at monthly intervals.

CROP AND DISEASE	RATE	REMARKS
CRUCIFERAE Downy Mildew	1 to 4 kg/ha	Commence spraying at 4 to 6 leaf stage or when disease is noted and repeat at 7 to 10 day intervals. Add a wetter/spreader to the mixture. Treat seedbeds at 3 to 5 day intervals. Dosage depends on plant density and size. Make sure that the plants are thoroughly wetted.
ORNAMENTALS Downy Mildew, Anthracnose and Rusts	150 to 200 g/ 100 ℓ water plus 25 mℓ LATRON B-1956 spreader/sticker per 100 ℓ spray or 1 mℓ per 5 ℓ	Apply at first signs of disease and repeat every 7 to 10 days. Dosage depends on severity of disease. Make sure that the plants are thoroughly wetted.
PAPAYA Black Speckle	2 kg/ha	Apply from flowering stage at 28 day intervals. Shorten intervals to 14 days under high

		disease challenge. For low volume application (in 25 to 40 ℓ water/ha) add mineral oil (light/narrow range) at a rate of 16 ℓ/100 ℓ spray mix.

24 HOUR EMERGENCY TEL. NO. (032) 533-0716

INFORMATION HOTLINE : TEL. NO.: (012) 842-0200

To view this label in Afrikaans, please contact the author at: andrea@cormack.uct.ac.za

APPENDIX F

GLEAN® 75 DF LABEL

Reg.No. (L 1672) Act 36/1947

Reg.Nr. (L 1672) Wet 36/1947

A water dispersible fine granule post-emergent herbicide, acting through the roots and foliage, which controls weeds in wheat *(Triticum aestivum)*, barley (*Hordeum vulgare)*, and oats (Avena sativa) in the Western, Southern and Eastern Cape; and for the control of certain broadleaf weeds, as indicated, in winter plantings of dryland wheat *(Triticum aestivum)* in the Summer Rainfall Region.

'n Waterdispergeerbare fyn korrel na-opkom-onkruiddoder wat deur beide die wortels en blare opgeneem word en onkruide beheer in koring *(Triticum aestivum)*, gars (*Hordeum vulgare*), en hawer *(Avena sativa)* in die Wes, Suid en Ooskaap; en vir die beheer van sekere breëblaar-onkruide, soos aangedui, in winteraanplantings van droëland koring *(Triticum aestivum)* in die Somerreënval gebied.

FOR FULL PARTICULARS SEE ENCLOSED LEAFLET

LEES INGESLOTE PAMFLET VIR VOLLE BESONDERHEDE

ACTIVE INGREDIENT

Chlorsulfuron (sulfonyl urea) .....750 g/kg..... Chlorsulfuron (sulfonielureum)

Net Mass

Netto Massa

AKTIEWE BESTANDDEEL

REGISTERED BY / GEREGISTREER DEUR:

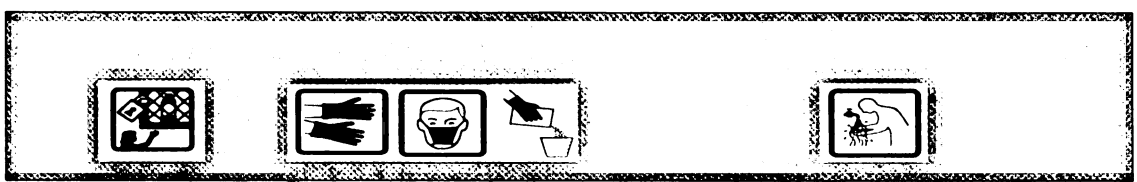
DUPONT DE NEMOURS INT S.A.
Co.Reg.No. 81/08502/10
P O BOX / POSBUS 3332
HALFWAY HOUSE 1685
Tel: (011) 654-8600

DISTRIBUTED BY / VERSPREI DEUR:

UN No./Nr. 2763

BATCH NUMBER
DATE MANUFACTURED

LOTNOMMER
DATUM VERVAARDIG



® GLEAN is the registered trademark and product of /
® GLEAN is die geregistreerde handelsmerk en produk van
E I Du Pont de Nemours & Co / Inc, Wilmington, Delaware 19898, USA / VSA.

GLEAN® 75 DF

Reg. No L1672 (Act 36/1947)

A water dispersible fine granule post-emergent herbicide, acting through the roots and foliage, which controls weeds in wheat *(Triticum aestivum)*, barley (*Hordeum vulgare)*, and oats *(Avena sativa)* in the Western, Southern and Eastern Cape; and for the control of certain broadleaf weeds, as indicated, in winter plantings of wheat *(Triticum aestivum)* in the Summer Rainfall Region.

ACTIVE INGREDIENT: Chlorsulfuron (sulfonyl urea) ..... 750 g/kg

Registered by:
DUPONT DE NEMOURS INT S.A.
Co.Reg.No. 81/08502/10
P O BOX 3332
HALFWAY HOUSE 1685
Tel: (011) 654-8600

WARNINGS :

- The product may irritate eyes, nose, throat and skin.
- Keep out of reach of children, uninformed persons and animals.
- Store in a cool, dry place.
- Store away from food and feeds.
- **Aerial Application** : Notify all inhabitants in the immediate vicinity of the area to be sprayed and issue the necessary warnings. Do not spray over or allow drift to contaminate water or adjacent areas.
- Should the recommended dosage rate or time of application be exceeded, damage to the crop may occur.

Although this remedy has been extensively tested under a large variety of conditions the registration holder does not warrant that it will be efficacious under all conditions because the action and effect thereof may be affected by factors such as abnormal climatic and storage conditions; quality of dilution water, compatibility with other substances not indicated on the label and the occurrence of resistance of the weeds against the remedy concerned as well as by the method, time and accuracy of application. The registration holder furthermore does not accept responsibility for damage to crops, vegetation, the environment or harm to man or animal or for lack of performance of the remedy concerned due to failure of the user to follow the label instructions or to the occurrence of conditions which could not have been foreseen in terms of the registration. Consult the supplier in the event of any uncertainty.

PRECAUTIONS:

Do not smoke, drink or eat while using this product.
Prevent contamination of food, feeds, drinking water, water supplies and eating utensils.
For safety when mixing:

- Do not inhale dust.
- Wear eye protection (at least glasses).
- In the event of contact with eyes, wash with water immediately.
- Wear rubber gloves.
- In the event of contact with skin, wash with water and soap immediately.
- In the event of contact with clothes, remove and wash.

For safety when spraying:

- Do not inhale and avoid contact with the spray mist as much as possible.
- Avoid spray drift onto susceptible crops, grazing, rivers, dams and areas not under treatment.

For safety after spraying:

- Wash yourself.
- Change and wash work clothes.
- Clean applicator thoroughly after use using the following method:
  i. Drain tank completely then flush tank, boom and hoses with clean water. Drain again.
  ii. Fill the tank with clean water and add household ammonia (contains 3 % active) at the rate of 1 litre for every 100 litres water.Circulate the ammonia solution through the tank, boom and hoses for at least 15 minutes. Drain completely.
  iii. To remove traces of ammonia, rinse the tank with clean water and flush through booms and hoses.
  iv. Repeat step (ii).
  v. Nozzles and filters must be removed and cleaned separately with ammonia solution at the same concentration as above.
  vi. Any contamination on the outside of the spraying equipment should be removed by washing with clean water.

Do not spray, drain or flush equipment on or near desirable trees or plants or where their roots may extend.

CONTAINER DISPOSAL:

- Containers and packages must be completely emptied before being disposed of.
- Shake out thoroughly into the application hopper before destroying the empty container.
- Never re-use for any purpose.

RESISTANCE STATEMENT:

When herbicides with the same mode of action are used in the same land for several consecutive years, it is possible that a selection of naturally occurring resistant weed species may take place. These will propagate and become dominant. A weed species is resistant to a herbicide if it survives a treatment correctly carried out at the recommended dose and application timing.

If a weed species is resistant to one sulfonyl urea product (Glean® 75 DF, Granstar®, Harmony M® and Ally 20 DF® and BRUSH-OFF®) it can be expected that it will be resistant to all sulfonyl urea herbicides.

Development of resistance can be avoided by alternating with product having a different mode of action but the same effect on the weed species or by using a tank mixture of the two products.

USE RESTRICTIONS :

GLEAN® OR GLEAN® PLUS **ALLY20 DF/BRUSH-OFF.**

1. **Follow-up crops**

1.1 TREATED AREAS SHOULD NOT BE PLANTED WITH ANY CROP OTHER THAN CEREALS (WHEAT, BARLEY, OATS) WITHIN **20** MONTHS OF **GLEAN** TREATMENT. WHEAT MAY BE PLANTED AFATER SIX MONTHS, WHILE BARLEY AND OATS MAY BE PLANTED 10 MONTHS AFTER **GLEAN** APPLICATION.

TREATED AREAS SHOULD NOT BE PLANTED WITH ANY CROP OTHER THAN CEREALS (WHEAT, BARLEY, OATS) WITHIN 10 MONTHS OF **GLEAN** PLUS **ALLY20 DF** (Reg no: L3842) / **BRUSH-OFF** (L4535) TREATMENT. WHEAT MAY BE PLANTED WITHIN ONE MONTH, WHILE BARLEY AND OATS MAY BE PLANTED SIX MONTHS AFTER **GLEAN** PLUS **ALLY20 DF/BRUSH-OFF** APPLICATION.

1.2 **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** applied to soil with pH levels exceeding 6,5 (KCl) and/or soil containing free lime may result in longer residual activity in respect of follow-up crops.

2. **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** has a limited residual effect on germinating weeds, the control of which is affected by factors such as weed species, soil pH and soil moisture.

3. Erratic control/regrowth of weeds may occur if one or more of the following conditions exist:

3.1 Light sandy soils that:
- tend to leach
- tend to become waterlogged

3.2 Excessive stones covering the soil surface

3.3 Application later than four weeks after emergence of weeds in the Western, Southern and Eastern Cape.

3.3 A low plant density

Under risky conditions described under 3.1 and 3.2, application of the herbicide should take place not later than two weeks post-emergence of the weeds.

4. **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF GLEAN** may not be used on the oats cultivar Heros.

5. Where certain climatic conditions (such as lengthy wet, cold period) prevail soon after application, then the use of **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** can lead to a yellowing of the leaves of the plants and evetually to temporarily retarded growth.

6. Copper oxychloride should not be applied with **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** at concentrations exceeding 0,5 kg/ha. The application of tank mixtures **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** and copper oxychloride may result in yellowingof the laeves of the crop.

7. Tank mixtures with **HOELON EC** (Reg.no. L 3880) and or **Buctril DS** (Reg. L3350).

7.1 **GLEAN** and **HOELON EC** are compatible but **HOELON EC** may not bes used after a **GLEAN** application. Under sub-optimal conditions this mixture may lead to poor grass control. Do not apply a wetter when **HOELON EC** is used in tank mixture with **GLEAN.GLEAN** plus **ALLY20 DF/BRUSH-OFF** tank mixture is **not compatible** with **HOELON EC. GLEAN** plus **ALLY20 DF/BRUSH-OFF** mixtures should not be applied to wheat and barley within 10 days after the use of **HOELON EC. GLEAN** plus **ALLY20 DF/BRUSH-OFF** should not be applied before the use of **HOELON EC.**

7.2 **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** and **BUCTRIL DS** are compatible.

8. Under no circumstances should unused spray mixture be kept overnight.
9. Do not spray **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** or any of the above-mentioned tank mixtures to cereals which are growing under stress conditions (stress conditions can result from water logging, drought, disease, insect damage and mineral element deficiencies, especially nitrogen).
10. **Undersown cereal: GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** must not be applied to cereals undersown with pastures.
11. Dilution water: Use only water of which the quality is suitable for overhead irrigation. Avoid water with a conductivity exceeding 1.0mS/cm, or with a resistanceof less than 300 ohm and/or pH higher than 8.
12. Do not apply **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** in combination with insecticides containing chlorpyrifos.
13. Rain immediately after application (before the spray deposit has dried) may adversely affect the efficacy of the herbicide.

DIRECTIONS FOR USE: **USE ONLY AS DIRECTED**

- A dosage rate variation of as much as 7,5 % can occur if the **GLEAN** measuring cup is used to measure the required dosage rate. For total accuracy the dosage rates must be weighed out.
- Apply **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** between the 3-5 leaf stage of the crop in the Western, Southern and Eastern Cape and **GLEAN** plus **ALLY20 DF / BRUSH-OFF** plus BUCTRIL DS tank mixture from the 3 leaf stage of the crop until before it canopies in the Summer Rainfall Region.
- **GLEAN** and TOPIK 240EC (L4250) or TOPIK 80 EC (L4777) may be applied as a tank mixture.
- Apply **GLEAN, GLEAN** plus BUCTRIL DS tank mixture, **GLEAN** plus **ALLY20 DF /BRUSH-OFF** and GLEAN plus **ALLY20 DF / BRUSH-OFF** plus BUCTRIL DS tank mixture as a post-emergence spray both of crop and weeds. Prepare only sufficient spray for immediate use, in the following manner:

PRE-MIXING:

Mix the required amount of **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** with a small amount of water to form a smooth cream without any remaining granules.

MIXING:

1. Half fill the spray tank or pre-mix tank in case of aerial application with water.
2. Add the creamed product to the tank through a sieve. Top up with water while agitating continuously, then proceed as follows:
   - 2.1. **High volume (e.g. by ground sprayer)**
     - 2.1.1. **GLEAN** or **GLEAN** plus **ALLY20 DF/BRUSH-OFF application:** Add the required amount of BP AGRIPRON SUPER (L3022) or CITOWETT (L2986) or AGRAL 90 (L2987) to the spray mixture and wait until thoroughly mixed before application.
     - 2.1.2. **GLEAN plus HOELON EC application:** Add the required amount of HOELON EC to the spray mixture while topping up with water and still agitating. Apply directly after thorough mixing.
     - 2.1.3. **GLEAN plus BUCTRIL DS application:** Add the required amount of BUCTRIL DS to the spray mixture while topping up with water and still agitating. Apply directly after thorough mixing.
     - 2.1.4. **GLEAN plus BUCTRIL DS plus HOELON EC application:**

Add the required amount of HOELON EC to the spray mixture while topping up with water and still agitating. After thorough mixing, start to add the required amount of BUCTRIL DS to the spray mixture while further topping up with water and still agitating. Apply directly after thorough mixing.

2.1.5 **GLEAN** plus **ALLY20 DF/BRUSH-OFF** plus **BUCTRIL DS application :**

Add the required amount of BUCTRIL DS to the spray mixture while topping up with water while still agitating. After thorough mixing start to add the required amount of CITOWETT or BP AGRIPRON SUPER or AGRAL 90 to the spray mixture while still agitating. Apply directly after thorough mixing.

2.2. **Low volume (e.g. by aircraft)**

Sprinkle the correct amount of GET-DOWN (L2405) onto the surface of the most turbulent portion of the spray mixture. Add the required amount of CITOWETT or BP AGRIPRON SUPER or AGRAL 90 to the spray mixture and allow to agitate for at least two minutes, so as to ensure thorough mixing before the mixture is pumped into the aircraft.

NOTE : Ensure that thorough agitation of the spray mixture is maintained at all times

APPLICATION:

1. **Ground Application**

Apply by means of a tractor mounted boom sprayer which is correctly calibrated to deliver at least 200 litres spray mixture/ha at a constant speed and pressure (100 - 200 kPa) to ensure an even delivery. Avoid overlapping of swaths and close the nozzles while starting, slow movement, turning and stopping to prevent over-application.

2. **Aerial Application**

Ensure a uniform and even distribution of spray material with a minimum loss during application. To achieve this, the following conditions must be met:

2.1. A spray swath resulting in even distribution is essential, as in the case of contact weed killers.
2.2. Apply a minimum of 30 litres mixture/ha, preferably with whirljet nozzles.
2.3. A minimum of 25 - 40 droplets per square cm must reach the target area.
2.4. Employ a droplet spectrum with a VMD of 250 - 300 microns.
2.5. Maintain an altitude of 3 m above the target area at wind speeds of 0 - 8 km/h and 2 m at wind speeds of 8 - 15 km/h. Spraying must stop when wind speeds exceed 15 km/h. Avoid gusting wind conditions.
2.6. Do not spray when the relative humidity (RH) drops below 45 %.
2.7. Do not spray under excessively high temperatures.
2.8. Accurate marking of spray swaths is essential.
2.9. It is important to obtain assurance from the aerial spray contractor that the above specifications will be adhered to.

COMPATIBILITY

GLEAN or **GLEAN** plus **ALLY20 DF/BRUSH-OFF** are compatible with **AGRAL 90** (L2987) **BP AGRIPON SUPER** (L 3022) BUCTRIL DS (L 3350), **CITOWETT** (L2986) **TOPIK 240 EC** (L4250), TOPIK 80 EC (L4777) and the trace elements ZINC OXIDE (B2096), MANGANESE SULPHATE (B647), COPPER OXYCHLORIDE (B2106).

APPLICATION TABLE A : ONLY FOR THE WESTERN, SOUTHERN AND EASTERN CAPE

CROP	RATE OF PRODUCT/ha	REMARKS
Ground and Aerial	**GLEAN** 15 - 17,5 g	Use the higher dosage of GLEAN for severe weed

Application Wheat *(Triticum aestivum)* Oats *(Avena sativa)* Barley *(Hordeum vulgare)*	plus 50 ml CITOWETT / 100 litre spray mixture **or** 50 ml AGRAL 90 / 100 litre spray mixture *OR* **GLEAN** 12,5 g plus BUCTRIL DS 250 mℓ *OR* 8g **GLEAN** plus 10 g **ALLY20 DF (3.5g BRUSH-OFF)** plus 50 ml CITOWETT / 100 litre spray mixture **or** 50 ml AGRAL 90 / 100 litre spray mixture	infestation. Apply as a post-emergence spray when the cereal crop is in the 2 – 5 leaf stage, but not later that the recommended time of application as indicatd below. **Note on Aerial Application:** The addition of **50g GET-DOWN/100 litre spray mixture** is recommended for Aerial application to improve coverage. **NOTE:** See also use restrictions No: 3.1, 3.2 & 3.3 **Oats:** Leaf scorch may occur, but is of a temporary nature and has no adverse effect on the grain yield. **Refer also 'NOTES' below.**

NOTES :

- Do not apply if the crop is growing under stress, such as drought, excessive moisture, etc.
- Moderate chlorosis and/or shortening of straw length may occur after application but yields will not be adversely affected. DO NOT exceed the recommended dosage rate.
- Established weeds not killed by cultivation and showing signs of regrowth will not be controlled.
- Best results are obtained whilst weeds are actively growing under moist conditions during the period of control.
- For mixing instructions refer to 'DIRECTIONS FOR USE'

Table 1 : <u>WEEDS CONTROLLED IN THE WESTERN, SOUTHERN AND EASTERN CAPE: GLEAN APPLICATION @ 15-17g/ha plus wetter</u>

The following weed species are normally controlled if sprayed from seedling up to the stage indicated:

BOTANICAL NAME	COMMON NAME	TIMING OF APPLICATION
Amsinckia menziesii	Fiddleneck	Post-emergence, but not later than 4 weeks post-emergence of the weeds.
Anagallis arvensis	Pimpernel	
Chenopodium album	White goosefoot	
Erodium moschatum	Musk heron's bill	
Lepidium africanum	Pepper cress	
Oxalis latifolia	Red garden sorrel	
Oxalis pes-caprae	Yellow sorrel	Under risk conditions as described in 3.1 and 3.2 (use restrictions) application should take place not later than 2 weeks post-emergence of the weeds.
Pentzia grandiflora	Large stinkweed	
Penztia suffruticosa	Small stinkweed	
Polygonum aviculare	Prostrate knotweed	
Raphanus raphanistrum	Wid radish	
Sisymbrium thellungii	Common wild mustard	
Spergula arvensis	Corn spurry	
Stellaria media	Chickweed	

NOTE: **Supression of** *Lolium temulentum* (darnel) can be obtained provided **GLEAN** is applied before the two-leaf stage of this weed.

Table 2 : <u>WEEDS CONTROLLED IN THE WESTERN, SOUTHERN AND EASTERN CAPE:</u>
Application of 8g Glean plus 10g ALLY 20DF/BRUSH-OFF. Control of the weeds listed in Table 1 above plus the following weeds in Table 2. Also refer corresponding notes.

BOTANICAL NAME	COMMON NAME	TIMING OF APPLICATION
Amaranthus spinosus	Thorny pigweed	Post-emergence, but not later than 4 weeks post-emergence of the weeds. Under risk conditions as described in 3.1 and 3.2 (use restrictions) application should take place not later than two weeks post emergence of the weeds
Cenia turbinata	Goose daisy	
Emex australis	Spiny emex	
+*Foeniculum vulgare*	Fennel	
* *Fumaria muralis*	Fumitory	
Medicago polymorpha	Burclover	
Plantago lanceolata	Narrow-leaved ribwort	
Poa annua	Winter grass	
Sonchus oleraceus	Spiny sow thistle	
-*Vicia hirsuta*	Tiny purple vetch	
-*Vicia sativa*	Broad leaved purle vetch	

NOTE: Supression of *Lolium temulentum* (darnel) can be obtained provided **GLEAN** plus **ALLY 20 DF/BRUSH-OFF** is applied before the two-leaf stage of this weed.

* Erratic control of *Fumaria muralis* may occur, but more constant control may be expected if the application is made to young plants (maximum two true leaves)

\+ Suppression of ***Foeniculum vulgare*** (fennel) can be obtained with a post-emergence application provided the application is made not later than four weeks post emergence of the weeds.

– Suppression of ***Vicia hirsuta (tiny purple vetch)*** and ***Vicia* sativa** (broad-leaved purple vetch) can be obtained with a post-emergence application provided the application is made not later than four weeks post-emergence of the weeds. Due to a long germination period these weeds can germinate after the application of **GLEAN** plus **ALLY 20DF/BRUSH-OFF** in which case they will not be controlled.

Table 3 : <u>WEEDS CONTROLLED IN THE WESTERN, SOUTHERN AND EASTERN CAPE:</u>
<u>Application of 12.5g GLEAN plus 250ml BUCTRIL DS / ha</u>

BOTANICAL NAME	COMMON NAME	TIMING OF APPLICATION
Emex australis	Spiny Emex	Post-emergence, but not later than 4 weeks post-emergence of the weeds. Under risk conditions as described in 3.1 and 3.2 application should take place not later than 2 weeks post-emergence of the weeds.
Oxalis pes-caprae	Yellow sorrel	
Pentzia grandiflora	Large stinkweed	
Polygonum aviculare	Prostrate knotweed	
Raphanus raphanistrum	Wild radish	
Spergula arvensis	Corn spurry	

<u>APPLICATION TABLE B :</u>
<u>ONLY FOR THE SUMMER RAINFALL REGION</u>

CROP	RATE OF PRODUCT/ha	REMARKS
Ground application and Aerial application: ONLY DRYLAND WHEAT (*Triticum aestivum*)	15 - 17,5 g **GLEAN/ha** plus 500 ml **BP AGRIPRON SUPER** / 100 litre spray mixture ***or*** 100 ml **CITOWETT** / 100 litre spray mixture ***or*** 100 ml **AGRAL 90** / 100 litre spray mixture ***OR*** 8g **GLEAN** plus **ALLY 20 DF** (or 3.5g **BRUSH-OFF** L 4535) plus 250ml **BUCTRIL DS** / ha **and** 250ml **BP AGRIPRON SUPER** /100 litre spray mixture or 100 ml **CITOWETT** / 100 litre spray mixture or 100 ml **AGRAL 90**/100 litre spray mixture	Use the higher dosage of **GLEAN** for severe weed infestation. Apply as a post-emergence spray when the cereal crop is in the 2 - 5 leaf stage onwards, but before the crop canopies and after the weeds have emerged and have not exceeded the maximum recommended stage as indicated below in the weed table. **NOTE:** See also use restrictions No: 3.1, 3.2, & 3.3 **NOTE:** On Aerial Application: The additioon of **50g GET-DOWN/100 litre spray mixture** is recommended for aerial application to improve coverage. Refer also notes below.

NOTES :

- Do not apply if the crop is growing under stress, such as drought, excessive moisture, etc.
- Moderate chlorosis and/or shortening of straw length may occur after application but yields will not be adversely affected. DO NOT exceed the recommended dosage rate.
- Best results are obtained whilst weeds are actively growing under moist conditions during the period of control.
- Established weeds not killed by cultivation and showing signs of re-growth will not be controlled.
- For mixing instructions refer to 'DIRECTIONS FOR USE'.

TABLE 4: WEEDS CONTROLLED IN THE SUMMER RAINFALL REGIONS: GLEAN APPLICATION @ 15-17.5G/HA PLUS WETTER

The following weed species are normally controlled if sprayed from seedling up to the stage indicated. Weeds must be actively growing under **moist** conditions:

BOTANICAL NAME	COMMON NAME	WEED APPLICATION STAGE
Chenopodium album	White goosefoot	5 cm tall
Helianthus annuus	Volunteer sunflower	2 - 6 leaves
Raphanus raphanistrum	Wild radish	5 cm tall
Sisymbrium thellungii	Common wild mustard	3 - 4 leaves

NOTE: Weeds germinating after the application of **GLEAN** will not be controlled.

TABLE 5: WEEDS CONTROLLED IN THE SUMMER RAINFALL REGION: 8G GLEAN PLUS 10 G ALLY20 DF (OR 3.5 G BRUSH-OFF) PLUS 205 ML BUCTRIL DS/HA.
Control all weeds listed in Table 4 plus the following weeds listed in Table 5.

The following weed species are normally controlled if sprayed from seedling up to the stage indicated. Weeds must be actively growing under **moist** conditions:

BOTANICAL NAME	COMMON NAME	MAXIMUM WEED STAGE AT APPLICATION
Bilderdykia convolvulus	Climbing knotweed	5 cm tall
Chenopodium album	White goosefoot	5 cm tall
Polygonum aviculare	Prostrate knotweed	5 cm ranks
Raphanus raphanistrum	Wild radish	3 - 4 leaves
Spergula arvensis	Corn spurry	5 cm tall

NOTE : Weeds germinating after the application of **GLEAN** plus **ALLY20 DF (or BRUSH-OFF)** plus **BUCTRIL DS** will not be controlled.

Trade marks acknowledged :

BUCTRIL DS	- Aventis
CITOWETT	- BASF
GET-DOWN	- Airflo Systems
HOELON	- Aventis
BP AGRIPRON SUPER	- BP South Africa (Pty) Ltd.
TOPIK	- Syngenta
AGRAL 90	- Kynoch Chemicals t/a Applied Chemical Products

To view this label in Afrikaans, please contact the author at: andrea@cormack.uct.ac.za

APPENDIX G: Factor Analysis Statistics For Chapter Seven

This appendix lists some of the more important findings for the factor analysis conducted between the risk perception and risk communication variables in Chapter Seven.

Eigenvalue's for Risk Perception Variable:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.667	17.778	17.778	2.667	17.778	17.778	2.265	15.100	15.100
2	1.980	13.202	30.980	1.980	13.202	30.980	1.970	13.131	28.231
3	1.564	10.426	41.406	1.564	10.426	41.406	1.648	10.984	39.216
4	1.157	7.712	49.118	1.157	7.712	49.118	1.310	8.732	47.948
5	1.029	6.861	55.979	1.029	6.861	55.979	1.205	8.031	55.979
6	.912	6.077	62.056						
7	.891	5.942	67.998						
8	.826	5.504	73.502						
9	.817	5.446	78.948						
10	.692	4.612	83.560						
11	.680	4.536	88.095						
12	.623	4.156	92.251						
13	.456	3.042	95.293						
14	.416	2.776	98.069						
15	.290	1.931	100.0						

Extraction Method: Principal Component Analysis.

Eigenvalues for Risk Communication Variable:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.104	23.877	23.877	3.104	23.877	23.877	1.775	13.656	13.656
2	1.500	11.535	35.412	1.500	11.535	35.412	1.770	13.614	27.270
3	1.238	9.524	44.936	1.238	9.524	44.936	1.676	12.889	40.159
4	1.186	9.121	54.057	1.186	9.121	54.057	1.492	11.480	51.639
5	1.070	8.228	62.285	1.070	8.228	62.285	1.384	10.646	62.285
6	.884	6.796	69.081						
7	.802	6.170	75.252						
8	.784	6.032	81.284						
9	.683	5.255	86.538						
10	.601	4.619	91.158						
11	.417	3.205	94.363						
12	.396	3.048	97.411						
13	.337	2.589	100.000						

Extraction Method: Principal Component Analysis.

Risk Perception Unrotated Factor Loadings:

Component Matrix[a]

	Component				
	1	2	3	4	5
B - 6: Are all pesticides poisonous?		.668			
B - 7: Are all pesticides dangerous?		.758			
RANKPEST			.501		
PESTSPRA					
WORKPEST			.553		
CHILDPLA			.669		
1. Can all pesticide make you sick straight away?					
2. Can some pesticides make you sick years from now?					
CHILD	.655				
ALLSICK	.511				
HARMSELF					.583
COWORK	.620				
FETUS	.580				
FERTILIT	.668				
F-5: Do you believe that PPE protects you from health effects?				.706	

Extraction Method: Principal Component Analysis.

a. 5 components extracted.

Risk Communication Unrotated Factor Loadings:

Component Matrix[a]

	Component				
	1	2	3	4	5
burn container				.558	
CORRECTC		.566			
UTENSILS	.695				
HANDPIC		-.543			
BOOTSPIC	.636				
SKULLPIC					
LOCKPIC	.610				
FISHPIC	.549				
EXPIRPIC	.549				
CROSSPIC			.617		
COWPIC					.551
RESPRPIC		.540			
GLOVEPIC				.517	

Extraction Method: Principal Component Analysis.

a. 5 components extracted.

Risk perception factor scores:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
REGR factor score 1 for analysis 1	115	-1.41575	3.75034	.0000000	1.00000000
REGR factor score 2 for analysis 1	115	-1.88773	2.04492	.0000000	1.00000000
REGR factor score 3 for analysis 1	115	-1.56040	2.10556	.0000000	1.00000000
REGR factor score 4 for analysis 1	115	-1.73803	3.52751	.0000000	1.00000000
REGR factor score 5 for analysis 1	115	-1.45859	3.50882	.0000000	1.00000000
Valid N (listwise)	115				

Risk communication factor scores:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
REGR factor score 1 for analysis 2	115	-1.76675	2.74747	.0000000	1.00000000
REGR factor score 2 for analysis 2	115	-2.17198	1.88088	.0000000	1.00000000
REGR factor score 3 for analysis 2	115	-2.44472	3.19242	.0000000	1.00000000
REGR factor score 4 for analysis 2	115	-2.02467	2.19508	.0000000	1.00000000
REGR factor score 5 for analysis 2	115	-1.72080	2.80239	.0000000	1.00000000
Valid N (listwise)	115				

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