BACTERIOLOGICAL QUALITY CONTROL OF MILK PRODUCTION IN THE SWARTLAND MUNICIPAL AREA

by

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Thesis presented in partial fulfilment of the
requirements for the degree of

Master of Public Administration

at the

University of Stellenbosch

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March 2007

DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature: ..... Date: March 2007

ABSTRACT

The aim of this thesis was to determine in terms of policy analysis why the bacteriological quality of milk in a particular area did not comply with statutory provisions during production. The policy issue is very complex due to the diversity of conditions that exist during the milking process, which may impact on the levels of bacteria in milk. Considering this diversity, various problematic conditions are likely to cause the bacteriological contamination of milk. Milk is regarded as safe for human consumption when laboratory quality tests indicate its bacteriological suitability. Intervention on the basis of milk control should assure that milk is produced and distributed within acceptable bacteriological levels.

The *ad hoc* milk safety strategy of the West Coast District Municipality (WCDM) was found to be inappropriate for the effective control of hygienic conditions during milk production. The existing strategy does not provide for suitable programmes to deal with this complex issue of policy and the suggestion is that it should be reviewed.

Judged on the basis of success factors, a decline in milk bacteriological quality for the WCDM area revealed factors that were not effectively controlled during milk production. During the research period the hygienic quality of milk from the WCDM area was regulated and judged primarily by means of laboratory quality tests. Food safety requires much more than merely relying on quality tests. It is imperative that milk laboratory analyses should in all instances be harmonised by means of an evaluation of hygiene and sanitary conditions during production.

How the problem situation with regard to milk quality is approached defines the implementation of strategy. The Environmental Health Practitioners (EHPs) of the WCDM have been implementing the requirements of applicable legislation, but each according to an individual approach. Such *modi operandi* provide for inconsistency in the execution of any policy. Implementing policy should be relevant, specific and adequate and should be target based. Consequently, the modification of policy is required to the extent of changing the approach when it does not comply with the afore-mentioned criteria, strategy or policy governing milk safety. More could be done by the WCDM to manage problems at milking sheds that is associated with the bacteriological quality of milk. Management control strategy is perceived to be inadequate and coupled with a lack of willingness to tackle the

crux of the problem. Implementing legislative policy necessitate an objective approach coupled with an appropriate strategy. The findings of the empirical analysis together with a discussion of the implementation of the WCDM milk control strategy explains the shortcomings that was experienced in that regard. Therefore, an improved policy framework is proposed for controlling milk safety at milking sheds. In addition, a strategic framework is also proposed to administer the milk safety policy by way of programmes.

OPSOMMING

Die doel van hierdie tesis was om, in terme van openbare beleidsanalise, te bepaal waarom die bakteriologiese kwaliteit van melk in ’n spesifieke gebied tydens die produksie daarvan nie aan die wetlike standaarde voldoen het nie. Hierdie beleidsvraagstuk word as kompleks beskou weens die uiteenlopende toestande wat tydens die melkproses ontstaan en wat ‘n impak op die bakterievlakke van melk kan hê. Inaggenome van hierdie diversiteit kan die besmetting van melk waarskynlik deur verskeie probleemtoestande veroorsaak word.

Melk word geag veilig te wees vir menslike gebruik wanneer laboratoriumkwaliteittoetse op die bakteriologiese geskiktheid daarvan aandui. Ingryping op grond van melkbeheer moet verseker dat melk binne die aanvaarde bakteriologiese vlakke geproduseer en verskaf word. Die *ad hoc* melkveiligheidstrategie van die Weskus Distrik se Munisipale (WDM) gebied is onvoldoende bevind vir die effektiewe beheer van higiëniese toestande tydens melkproduksie. Hierdie strategie maak nie voorsiening vir geskikte programme om hierdie komplekse beleidsvraagstuk te hanteer nie en die hersiening daarvan word voorgestel.

Geoordeel aan die hand van suksesfaktore, dui ‘n afname in die kwaliteit van melk vir die WDM gebied op faktore wat tydens melkproduksie nie effektief beheer was nie. Die higiëniese kwaliteit van melk binne die WDM gebied was tydens die navorsingstydperk primêr deur middel van laboratoriumkwaliteittoetse gereguleer en geoordeel. Voedselveiligheid vereis dat daar egter op meer as kwaliteittoetse gesteun word. Dit maak dit noodsaaklik dat die laboratoriumanalises van melk in alle gevalle aan die hand van evaluering van higiëniese en sanitêre toestande tydens melkproduksie geharmoniseer word.

Die manier waarmee die probleemsituasie met betrekking tot melkkwaliteit benader word, definieer die implementering van strategie. Die Omgewingsgesondheidspraktisyns (OGPs) van die WDM het die voorskrifte van die toepaslike wetgewing geïmplementeer, maar elkeen volgens ‘n eie benadering. ‘n Sodanige *modus operandi* maak voorsiening vir die inkonsekwente uitvoering van enige beleid. Die implementering van beleid moet relevant, spesifiek, geskik en moet doelgerig wees. Gevolglik waar voornoemde kriteria, strategie of beleid wat melkveiligheid aangaan nie nagekom word nie, noodsaak dit derhalwe ‘n aanpassing van beleid vir soverre die benadering tot strategie vir melkveiligheid geraak

word. Die WDM kan meer doen om probleme wat verband hou met die bakteriologiese kwaliteit van melk by melkstalle te bestuur. Die beheerstrategie van die bestuur word as onvanpas beskou en dit gaan gepaard met ‘n gebrek aan ywer om die essensie van die probleem aan te spreek.

Die inwerkingstelling van wetgewing noodsaak ’n objektiewe benadering gepaardgaande met ’n geskikte strategie vir die uitvoering van beleid. Die bevindinge van die empiriese analise tesame met ’n bespreking aangaande die implementering van die WDM melkbeheerstrategie bied ’n verduideliking van die tekortkominge in daardie verband aan. Derhalwe word ’n verbeterde beleidsraamwerk voorgestel om die melkveiligheid by melkstalle te beheer. Daarbenewens word ’n strategiese raamwerk om die melkveiligheidbeleid deur middel van programme te uit te voer, ook voorgestel.

DEDICATION

This thesis is dedicated to my late grandmother, Dianah Allies.

ACKNOWLEDGEMENTS

The following acknowledgements are made to all who have contributed towards my success.

My Heavenly Father, for His sufficient grace and strength.

My parents, Henry and Rachel Allies, for their continual encouragement, support and prayers.

Professor Fanie Cloete, who has diligently and tirelessly supervised my work throughout my study period.

Stalin Links, for his enduring patience and welcomed input and support throughout my studies.

The Milk Control Board of the former Cape Metropolitan Council, especially Suzette Howes, who provided me with the statistics required for this research.

Dr Carl Lombard of the Medical Research Council, for his guidance and support.

The West Coast District Municipality, for the approval granted to me to do this thesis.

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CHAPTER 1

METHODOLOGICAL ISSUES

1.1 Introduction

There were indications that the bacteriological quality of bulk tank milk from selected dairy farms within the Swartland Municipal Area (SMA), did not comply with legislative policy requirements. The microbial content of milk is a major feature in determining its quality (IDF Bulletin Doc. 256, 1991). Laboratory quality tests determine the types and levels of bacteria that are present in milk. These quality tests involve parameters for measuring compliance with statutory requirements. The analysis of sampled milk indicates the success that was achieved with hygiene control during milk production. Notwithstanding, the non-compliance of sampled milk indicates that milk is of substandard bacteriological quality, hence rendering milk unfit for human consumption. The phenomena that accompany non-compliance create a problem situation for which appropriate solutions to remedy this are contemplated. It is in that regard that the thesis was undertaken to identify in terms of an applicable policy process why the bacteriological quality of milk during production did not comply with statutory requirements.

Regarding the above, a suitable policy approach was identified to analyse policies and strategies for milk safety control at milking sheds that were current during the period 1997 to 2002, which was chosen for this thesis. Bacteriological quality control during milk production was investigated within the context of strategies applied by the Environmental Health Unit of the West Coast District Municipality (WCDM) to selected dairy farms within the SMA.

At local authority level, Environmental Health Practitioners (EHPs) are lawfully compelled in terms of the Health Act, Act 63 of 1977 (henceforth Act 63/1977) and the Foodstuffs, Cosmetics and Disinfectants Act, Act 54 of 1972 (henceforth Act 54/1972) to ensure the safety of the public health. A collaborative approach between the milk specialising unit of the Health Department of the City of Cape Town (HDCCT), formerly known as the Milk Control Board of the Cape Metropolitan Council, and the WCDM was pursued during the research period to gain effective control over milk safety. Laboratory reports on milk such as sampled by both the WCDM and the HDCCT were essential for policy planning. It was

assumed that the non-compliance of milk samples could be related to the ineffective implementation of milk bacteriological quality control policy strategies. The former Department of National Health and Population Development formulated policy concerning milk. This was advanced in a regulation under Act 63/1977 as well as regulations formulated under Act 54/1972. Compliance with the above-mentioned legislation implies that milk is safe for human consumption and distribution. The legislation enables a framework within which to construct uniform milk safety policy strategies for milking sheds. It is possible to assume that non-compliance with the regulations governing the bacteriological quality of milk indicates that the legislative policies are either inadequate or not conformed with.

To guarantee a comprehensive policy study with regard to the analysis of bacteriological quality during milk production, this thesis was conducted within the context of international, national and local parameters. In this regard, the policies of the Food Agricultural Organisation (FAO) and the World Health Organisation (WHO) were considered; food control legislation pertaining to the national sphere of government was scrutinised; and food control legislation of the local sphere of government, in this case the WCDM, was also scrutinised and evaluated. Current policies with regard to milk safety control in both the national and local sphere of government were evaluated for this study.

1.2 Motivation for the Research

Local authorities have a legal obligation to ensure that milk distributed in their respective areas is safe for human consumption and distribution. The numbers of bulk tank milk samples that annually comply with the regulations measure the success of this legal obligation. However, analyses of laboratory reports of milk sampled during the period 1997 to 2002 involving both the HDCCT and the WCDM were contra-indicative of compliance. Despite the attempt of the WCDM to control the safety of milk, improvement in bacteriological quality seems to be insignificant. This phenomenon has motivated the author to do the thesis. The author is currently tasked at the WCDM to ensure that food safety is maintained. The following question confronts this thesis regarding milk safety control:

- Could the milk safety strategy of the WCDM effectively control the bacteriological quality of milk?

In the chapters that follow, answers to the above question will articulate whether the WCDM policy was addressed within the context of the problem and the risk connected to it.

1.3 Problem Statement

There were indications that the bacteriological quality of milk in the SMA did not comply with statutory requirements and hence was not safe for human consumption. Non-conformance with legislative standards was observed in the statistics of both the HDCCT and the WCDM for the period 1997 to 2002. This could indicate that the implementation of policy strategies was not effective in attaining milk control. Lack of appropriate management control strategy is assumed to have been a contributing factor. Such a situation creates a problem for which appropriate policy intervention with solutions are sought, to improve the milk safety control system.

1.4 Research Question

Can the bacteriological quality of milk produced by dairy farms in the Swartland municipal area be improved by more effective implementation of policy strategy with regard to food safety control during milk production?

1.5 Research Methodology

This thesis focused on strategies for controlling the bacteriological quality of milk during production. The relevant policy was viewed through the existing policy problems encountered with regard to milk safety. Decisions that were advocated as policy options for the improvement of policy problems were also considered. All decisions around the policy issue were scrutinised in terms of national legislation, as well as decisions taken at departmental level. The analytical focus of this study made it possible to work on policy-related problems and shortcomings that were encountered in the implementation process to achieve meaningful results.

In Chapter 2, the definitions of terms are provided to explain the wording in the text. Furthermore, an appropriate policy approach is discussed within a methodological framework to give a greater understanding of the research issue. It must be noted that the

meaning of milk safety corresponds to the meaning of food safety. Likewise, milk safety control corresponds in meaning to food safety control and these terms will be used interchangeably in this thesis. In Chapter 3, milk safety control and tools that can possibly be employed to control bacteria during the whole of milk production is discussed. Milk includes both raw milk and milk that has undergone pasteurisation. This thesis reviewed policy initiatives of the WCDM concerning milk safety, as well as how these policies were implemented. The policy successes and shortcomings are identified in the text, and measures for improvement are proposed. At local authority level, policies that relate to milk safety control and the execution thereof by the WCDM provided the unit of analysis for this thesis. Food control policies of the national sphere of government as well as policies of international organisations like the FAO and WHO were employed to inform this study.

This thesis focused on selected dairy farms situated within the SMA (see Figure 4). In the case of the HDCCT, the sample study consisted of milking sheds located in the SMA whose milk entered the Cape Metropolitan Area. Milk samples were taken from these milking sheds by officials of the HDCCT and were sampled in the HDCCT municipal laboratory. Only analyses of raw milk sampled from the farm bulk tank supplies were considered for analysis. The raw milk statistics of the HDCCT was only analysed for pathogenic bacteria. These sample analyses supported the objective nature of the policy issue.

Likewise, EHPs of the WCDM monitored milk for its bacteriological quality through samplings. These samples were analysed by the National Health Laboratory of the Department of Health. In this thesis the statistics of raw as well as pasteurised milk that were sampled by the WCDM will be analysed. Approximately 16 dairy farms were included in the WCDM sampling programme. Since the number of farms that were monitored by the local authorities in question differs considerably, the comparisons of the local authorities are done autonomously. The success of policy intervention that was introduced for controlling milk is measured on the basis of the distribution of sample compliance over a period of time. This research analysis a policy issue hence limiting the scope to the impact strategy had on raw and pasteurised milk quality during the period 1997 until 2002. In this regard, during the same period statistical data indicating the quality of milk for raw and pathogenic bacteria obtained from selected dairy farms are analysed. The 1998 statistics were not available and therefore were not included in the WCDM statistical analysis.

Hence, only available sample statistics will be included in this research. The statistics were analysed as raw data and served as the primary information for this thesis. Due to ethical considerations and the autonomy of the study, the names of farms that were monitored cannot be disclosed.

This is both a qualitative and quantitative study. Qualitatively, information was gathered from interviews that were conducted, inspection reports and questionnaires. Sampling reports served as directive for intervention. Interventions measures were determined by means of action taken with regard to samplings and recorded inspection reports that were followed as routine inspection and on cases where the bacteriological results were non-compliant. Quantitatively, information collected from interviewees was tested against the policy approach. This was expected to determine possible causes that contributed to policy inadequacy, policy failure or policy success. A summary of results from policymakers and implementers of the policy was presented. This measured the implications of the milk safety strategy. Consequently, both an inductive and a deductive approach were used to evaluate the policy issue.

Deductively, tentative goal sets and effectiveness measures applied by the WCDM comprise the evaluation of hygienic control of milking sheds (Miyakawa, 1999:177). In addition, secondary data of past research on the bacteriological quality control of milk was also utilised for this research. The reliability of this thesis is depended upon scientific data that is factual and accurate.

1.6 Definition of Terms

In this thesis, the following terms are used according to the definitions that are supplied to explain the wording in the text.

- **Contamination**

The introduction or occurrence of a contaminant in the food or food environment

- **Control Measure**

Any action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

- **Critical Success Factors**

Critical success factors are elements and components in which results, if satisfactory, will ensure successful corporate performance. They are critical to the organisation for ensuring that it will meet its goals or objectives. Critical success factors are focused, fluctuate and are conducive to short-term plans.

- **Effectiveness**

Effectiveness is the state of having produced a decided or desired effect.

- **Food Control**

Food Control means a mandatory, regulatory activity of enforcement by the competent health authority to provide consumer protection and ensure that all food during production, handling, storage, processing and distribution is safe, wholesome and fit for human consumption; conform to safety requirements; and is honestly and accurately labelled as prescribed by law. Food Control shall have the same meaning as milk control in this thesis and shall be used interchangeably.

- **Food Hygiene**

Food hygiene consists of all conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain.

- **Food Handler**

Any person who directly handles packaged or unpackaged food, food equipment and utensils, or food surfaces and is therefore expected to comply with food hygiene requirements.

- **Food Safety Control**

Food safety control is defined as a mandatory regulatory activity of enforcement by the relevant health authority to provide consumer protection and to ensure that all foods during consumption conform to safety requirements as prescribed by law. This definition has the same meaning for milk safety control.

- **Food Safety**

Food safety is the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use. This definition has the same meaning for milk safety.

- **Hazard Analysis**

The Hazard analysis is the process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for food safety production, handling, storage, processing, and distribution and are safe and fit for human consumption.

- **Indicators**

Indicators are benchmarks, targets, standards or other measures used to evaluate how well quality values and programmes are integrated.

- **Inputs**

Products or services obtained from others (suppliers) in order to perform job tasks. Material or information required to complete the activities necessary for a specified end result.

- **Inspection**

Activities such as measuring, examining, testing or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish

whether conformity is achieved for each characteristic ISO8402.

- **Measurable Outcomes**

Measurable outcomes are specific results that determine, corporately, how well critical success factors and business objectives are being achieved. They are concrete, specific and measurable.

- **Milk**

Milk shall refer to both raw as well as pasteurise milk unless otherwise indicated.

- **Milk Quality**

Milk quality shall refer to the bacteriological quality of milk.

- **Outputs**

The specified end result, materials, products or information provided to others.

- **Primary Production**

Those steps in the food chain up to and including, for example, harvesting, slaughter, milking.

- **Policy Development**

The complex and comprehensive process by which policy issues are identified, the public policy agenda is shaped, issues are researched, analysed and assessed, policies are drafted and approved and, once implemented, their impact is assessed.

- **Quality**

Quality is the total effect of the features of a process, product or service on its performance. Quality is related more to the relevance and value of each institution's

mission, purpose, goals, objectives and achievement of identified outcomes.

- **Quality Assurance**

Quality assurance is defined as a strategic management function that establishes policies related to quality, adopts programmes that meet the established goals and provides confidence that these are effectively applied.

- **Quality Audit**

A quality audit is an evaluation to verify the effectiveness of control. This includes the quality system, product and service quality, quality measurement, process control practices and laboratory reliability testing assessments.

- **Quality Standards**

Formally documented requirements against which performance can be assessed.

- **Risk**

Risk means an estimate of the likely occurrence of a hazard. Risk consists of both the probability and impact of disease.

- **Risk Assessment**

The essence of microbial risk assessment involves describing a system in which a microbial hazard reaches its host and causes harm.

- **Strategy**

Strategy can be defined as the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals.

- **Testing for Quality**

These are microbiological tests for milk that is specified in Regulation R 1256 of 1986. The application of quality principles is to achieve the integration of all functions and processes of the organisation.

- **West Coast District Municipality**

The West Coast District Municipality is also referred to as Environmental Health Unit and the two terms are used interchangeably.

1.7 Stages of the Research

Three stages were identified for the research process. Each stage consisted of 'clusters' of related questions and/or decisions. In the first stage the cluster of questions revolved around an understanding of the issue at hand. This is highlighted in Chapter 1 and Chapter 2.

The second cluster of questions related to what had taken place in response to the policy problem. This is discussed in Chapters 3 and 4. The third cluster of questions, which is discussed in Chapter 5, related to what was known of the previous efforts to address the policy issue that was being researched. In Chapter 1, the methodological issues are discussed as the first objective. This chapter is divided into various sections that develop a broader understanding of the issue under investigation. Answers to the above clusters of questions that are discussed in the different stages will provide a perspective on the safety of milk in the SMA.

In Chapter 2, the objective was to clarify the concepts of public policy as related to public policy analysis. Within the realm of policy issue analysis, an appropriate policy approach was identified to analyse strategies that were implemented by the WCDM to ensure the safety of milk produced at farm level. This approach is based on theory for policy with the analytical focus on the structuring and the advocating of the policy problem. The policy approach will enhance understanding of the importance of bacteriological quality control during milk production. The theory behind food safety is considered that specifically relate to the hygienic control of milk during production. In Chapter 4, the objective is, firstly, to

discuss international food safety policies. In this regard, policies of the WHO and the FAO were selected. This analysis specifically relates to the current food control policies for milking sheds established by WHO and the FAO. Secondly, the policies of national and local authorities are discussed. These are food control policies applied to regulate and control milk. This chapter provides an analysis of legislative policies pertaining to food safety control.

In Chapter 5, the empirical analysis of data collected for this thesis is discussed. In addition, the strategies that were implemented to control milk quality are therefore discussed and evaluated. The milk safety policies are evaluated in terms of adequacy, relevance, and how effective this was in addressing policy-related problems related to the bacteriological quality of milk. Furthermore, the statistical data are analysed, quantified and interpreted into meaningful results. Data gathered from interviews, questionnaires and the statistics collected for this thesis are also discussed in this chapter.

The sixth objective exemplifies the final and concluding chapter which present the findings and recommendations of this thesis. This will suggest policy guidelines that could improve on current legislation, policies and strategies with regard to the bacteriological quality of milk. Strategies and objectives are identified to improve on and to strengthen the control system for the bacteriological quality of milk. Finally, a milk policy framework is proposed as decision tool to manage the risks associated with milk bacteriological quality.

As far could be ascertained, no comprehensive research has been undertaken from the perspective of public policy analysis to analyse the issues of policy on bacteriological quality control of milk production in milking sheds in the SMA.

1.8 Conclusion

Efforts to control the bacteriological quality of milk are apparently insignificant as a result of a number of factors that are discussed in the chapter that follows. When situations meet crisis proportions a need arises for specific programmes to attend to specific problem situations. This thesis questions the implementation of policy with regard to the implementation of programmes to guarantee milk safety. It cannot be argued that no strategy was employed to control milk quality. However, the strategy that was followed by the WCDM leaves much to be desired. The different stages of policy are objectively

discussed in the chapters that follow with regard to the issue at hand; responding to the policy problem and previous efforts of the WCDM to address the policy problem being researched. The scanning of policies and strategies formulated internationally, nationally and locally serve as guideline for determining milk safety policy. As these policies were expected to vary, the challenge for this thesis was to collate the different viewpoints and perspectives governing approaches to the bacteriological quality control of milk to develop a workable, feasible, but effective strategy.

Environmental Health Practitioners (EHPs) have to perform a multiplicity of functions and are thereby challenged with the task to protect the health of the public. To realise this goal, the management approach serves as the driving force for assuring that these functions are attained and likewise obtain success with milk safety control. The transformation of health requires the focus of environmental health to be of a developmental nature. In this regard, the policy should be development-based. This includes both the determinant of the strategy as well as the implementation of strategy.

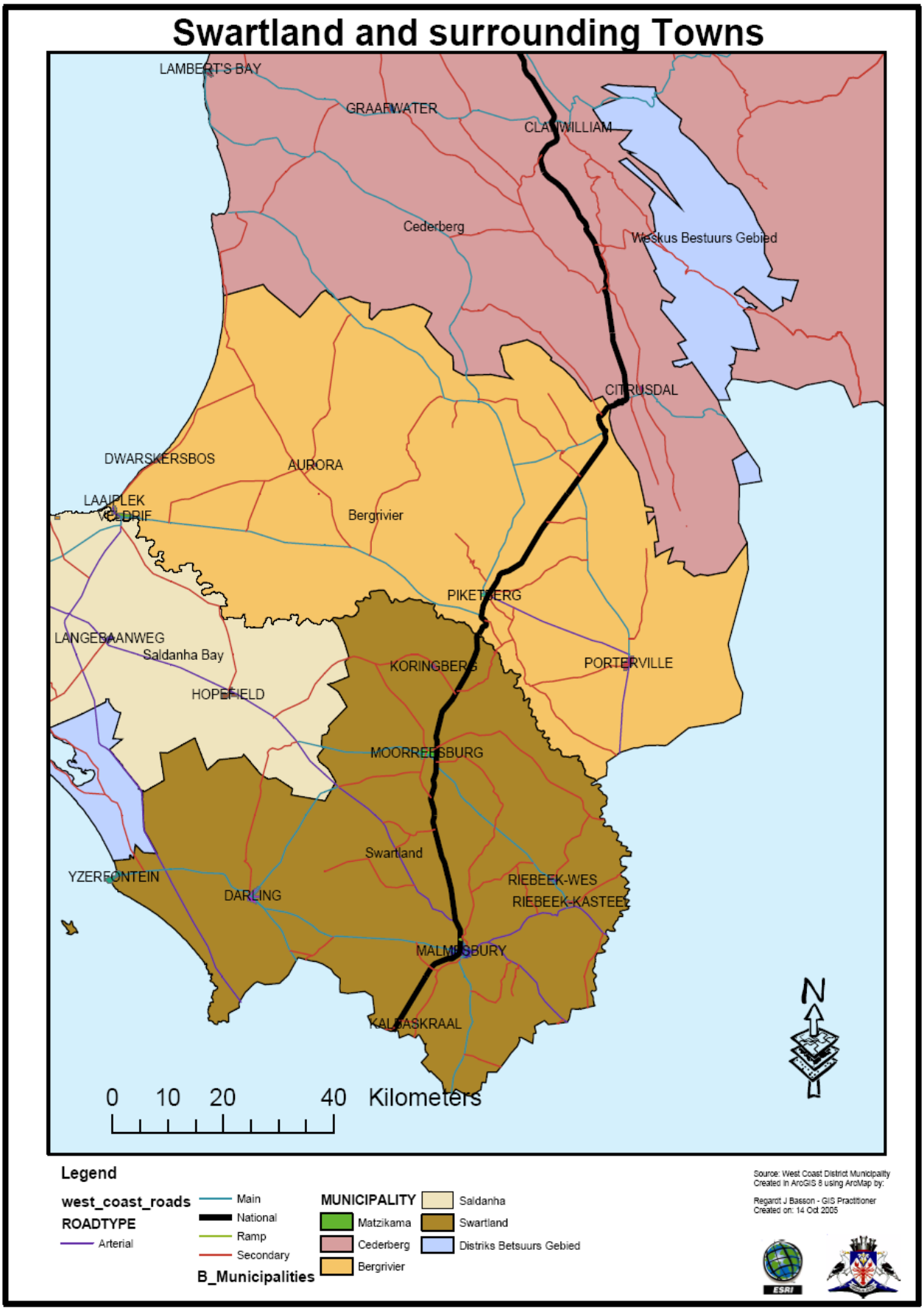


Figure 1: West Coast District Municipal Area

CHAPTER 2

THE PUBLIC POLICY ANALYSIS FRAMEWORK

2.1 Introduction

In this chapter, only those defining characteristics concerning public policy analysis are discussed in section 2.2. A policy approach is contextualised within a policy analysis framework that serves to articulate the policy issue that is discussed in the text. A suitable methodology relevant to a policy issue is employed within this framework. Analytical tools as well as analytical instruments are applied in the text to inform the policy issue and to measure the policy under scrutiny.

2.2 Defining Public Policy

The different stages of and views on policy illustrate the varied nature of public policy. While the following dimensions of policy are not assumed to depict comprehensively all the complex aspects of policy, only specific definitions concerning public policy as this relates to the issue under discussion are explained. In the sections below these definitions are viewed as complexity, policy demands, conduct of public affairs and purposive courses of action.

2.2.1 Public Policy is Complex

Grindle & Thomas (1991:2) view the study of public policy as a complex endeavour. "…*seen within the context of a series of questions, on choices among alternatives that may have both substantive and methodological implications*."

The Department of Health (1995:35) sees this complexity as the lack of co-ordination amongst the various health authorities, which contributes to the fragmentation of the functions. In addition, Miyakawa (1999:248) sees the complexity as stemming from methodological problems like multiple conflicting criteria and multidimensional measurement.

2.2.2 Public Policy as Policy Demand

Notwithstanding the above view, Anderson (1990:6-8, 89) conceptualised policy demands or claims to involve *"what governments actually do, not what they intend to do or what they say they are going to do; to be either positive or negative; to be based on law and be authoritative."* In this case, policy demands require effective strategies for taking action on milk safety control.

2.2.3 Public Policy as Conduct of Public Affairs

Policy is explained with reference to Dunn's (1994:33) meaning as *"the conduct of public affairs or the administration of government."* These conducts, as seen by Wissink (1988:1-4) and Hogwood & Gunn (1984:13-24), are a *"field of activity," example a government's health policy.* In addition, this may include an expression of *"a desired state of affairs, to specific proposals, decisions of government, formal authorisation, programme, output, outcome, theory or model* or as *a process*."

2.2.4 Public Policy as Purposive Courses of Action

For Anderson (1990:5, 6-8, 89), policy is intentional, deliberate and outcome-based and is best illustrated as a '*purposive course of action followed by an actor or set of actors in dealing with a problem or matter of concern'.* In contrast, Friedrich (as cited in Anderson 1990) views it as merely a recommendation or suggestion.

The above meanings highlight the essential features of policy against which this policy study will be measured. Public policy is an integral part of the policy analysis process and thus necessitates knowledge of policy analysis. In view of this, different approaches on policy analysis are explained in section 2.4.3.

2.3 Public Policy Analysis

In this section, the policy issue approach is discussed within a policy framework. The efficacy of the framework is tested against what is known about the policy problem, in order to determine whether extensive new data is required to operationalise the selected approach (Miyakawa, 1999:183). In Figure 1, public policy analysis is discussed by the

generic process model that promotes the significance of the policy approach. This model is identified as methodology for this research.

2.4 The Generic Process Model

The generic process model in Figure 2 separates the process facilitation elements from the policy analysis actions. In assisting towards solutions for any policy issue, this model proposes specific requirements and key issues to be addressed during each phase (Cloete & Wissink, 2000: 49). The model is an analytical tool that consists of various phases. It explains the complexity of the policy issue, reducing it to a more manageable form (Parsons, 1995: 80). In addition, it is also used to interpret the milieu of the environment and assist in explaining and predicting the outcome of a specific policy choice (Hanekom, 1987:46).

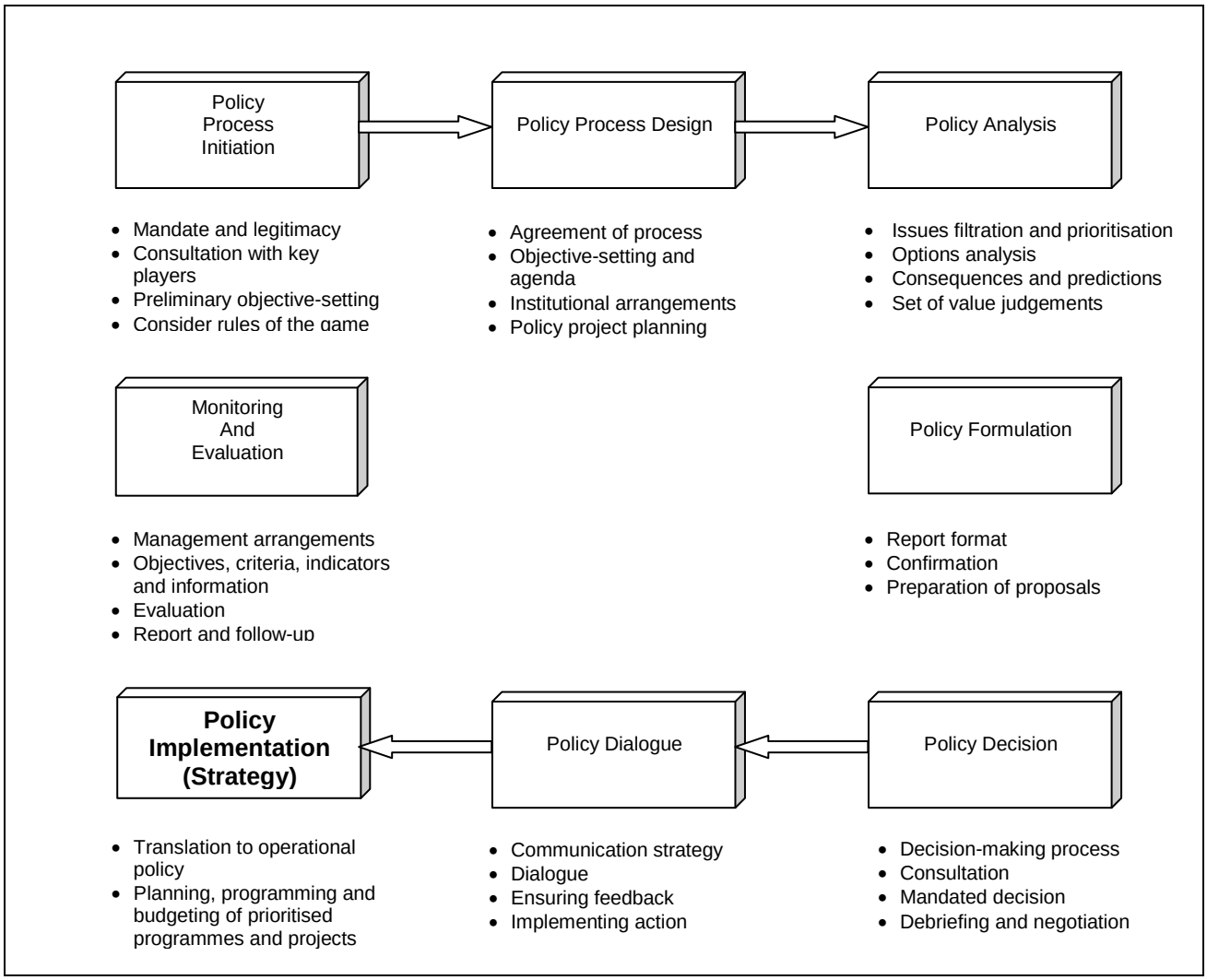


Figure 2: Key considerations for phases of the generic process model. Source: De Coning, as cited in Cloete & Wissink, 2000.

The phases of the generic process model are inter alia policy initiation, policy process design, policy analysis, policy formulation, decision-making, policy dialogue, implementation, and monitoring and evaluation.

2.4.1 Policy Process Initiation

Policies are initiated through a process and these, to Hogwood & Gunn (1984:27), are a complex set of events determining what actions government will take, and what effects those actions will have on social conditions. The initiation of any process should be legitimate and thereby require conformity to the rule of fairness and justice. Consultation with key role players should be the primary undertaking (De Coning, as cited in Cloete & Wissink, 2000). The underlying principles that respond to changes in the operating environment emphasise both internal and external consultation. The principles that could improve the policy development and decision-making process are (Health Canada, August 2000):

- Involving interested and affected parties
- Communicating in an effective way
- Using a broad perspective
- Using a collaborative and integrated approach
- Making effective use of sound science advice
- Using a “precautionary” approach
- Tailoring the process to the issue and its context
- Clearly defining roles, responsibilities and accountability
- Striving to make the process transparent

In addition, De Coning (as cited in Cloete & Wissink, 2000) has identified preliminary objective setting and the consideration of rules to be included in the policy initiation process.

2.4.2 Policy Process Design

Wildavsky (as cited in Weimer, 1993) views policy design as the art of finding solutions to the policy problems that specify desirable relationships between “manipulability means and obtainable objectives”. In contrast, Weimer (1993) defined policy design as the

specification of candidate policies for improving some social condition. He identified borrowing and tinkering as the two specific techniques for alternative policy in the design phase. Firstly, borrowing is defined as the search for policy alternatives that have been used in other circumstances to solve similar policy problems.

Secondly, tinkering is defined as the manipulation of the dimensions of a policy alternative to generate other alternatives. According to Wholey, Hatry & Newcomer (1994:19) policy design models identify the following factors that connect programme activities to programme goals:

- The resources allocated to the programme
- Intended programme activities and expected programme outcomes
- Assumed causal linkages as well as intermediate outcome objectives

2.4.3 Policy Analysis

The analysis for policy requires an acceptable policy approach. Wissink (1990:70) sees policy analysis to refer to the methodological activity or approach, which may be utilised for problem solving purposes in government. The policy approach adds significance to this policy analysis framework and a greater understanding of the policy issue. The analytical focus is on the structuring and advocating the policy problem.

Miyakawa (1999:224) views the elements of analyses as the objectives, the alternatives, the impacts, the criteria, and the models.

2.4.3.1 Methodological Approaches to Policy Analysis

The model depicted in Table 1 is not included in this research to compare different models but is merely to elucidate the analytical approach relating to a policy issue analysis. This approach distinguishes between the analytical focus and analytical instruments. The elements of the analytical focus are the structuring of the policy problem and advocating the policy into meaningful results. Similarly, the elements of the analytical instruments are structuring the nature of policy problems and thereby determining and forecasting the best policy solutions.

This policy issue analysis is useful for decision making in environmental health since it identifies policy problems with regard to milk safety control as well as suggesting solutions thereto. Furthermore, it also views how the milk safety policy process was advocated for controlling milk safety in the SMA.

2.4.3.2 Policy Issue Analysis

Hogwood & Gunn (1984:108) defined a policy issue as the processes by which the issue is further explored, articulated and possibly quantified in terms of likely causes, components, and consequences. According to Miyakawa (1999:180) the issue paper attempts to identify the real problem or problem set.

The analytical focus and instruments are those elements of the methodological framework that measure the policy issue (Cloete & Wissink, 2000:73-74). It furthermore also identifies policy problems and policy shortcomings. The analytical approach involving issue analysis, on which this policy study is based, is highlighted in Table 1. The policy issue, bacteriological quality control during milk production, is further structured and analysed within this framework. In addition, the components for this policy issue involve structuring the policy problem as well as advocating the policy.

a) Policy Problem Structuring

The genesis of a policy issue involves the recognition of a problem. The specific decisions Concerning a policy issue concern deciding that there is a problem; deciding to do something about it; deciding the best way of proceeding and deciding to legislate (Anderson, 1999:98).

For Rist (2005:7), problem definition includes the understanding of prior initiatives, community and organisational receptivity to particular programmatic approaches, and the kinds of impacts that might emerge from the different intervention strategies.

Anderson (2000:88) in addition defines a policy problem as a condition or situation that produces needs due to dissatisfaction among people and for which relief or redress is sought through governmental action. Mac Rae & Whittington (1997:29) described a problem condition as a state of affairs about which the public may be concerned.

The problem condition sets the policy problem in prominent and delineated categories with comparable features. A problem-structuring phase, definition of alternative solutions to the policy problem and forecasting their individual effects and impacts are elements that is proposed by Cloete & Wissink (2000: 73-74) for solving policy issues.

Analytical Approaches	Analytical Focus	Analytical Instruments
Policy Content Analysis	**Interpretation of policy Content**	**Judicial practice and administrative Law**
	Comparative policy analysis	**Correlation of policy content**
	Policy dynamics	**Indicators of policy change**
	Policy pathology	**Problems and ailments of the policy process**
Policy Systems Analysis	**Policy behavioural studies**	**Influence and decisions of shareholders and stakeholders**
	Policy institutional studies	**Role of institutions and related organisations**
	Policy process studies	**Agenda-setting procedures of policy-making bodies and committees**
Policy Issue Analysis	**Policy problem structuring**	**Structure of the nature of policy problems**
	Policy recommendation (advocacy)	**Determining and forecasting policy solutions**
Policy Outcome Analysis	**Policy monitoring**	**The outcome of policy actions**
	Policy impact evaluation`	**The value of policy actions**
Policy Values Analysis	**Community values and general morality or moral guidelines**	**Values and ethical considerations supporting specific policy choices and / or actions**

Table 1: Approaches to Policy Analysis. (Cloete & Wissink, 2000)

For a policy problem to achieve agenda status, Hogwood & Gunn (1994:120-125) proposed the disaggregation of the problem into the following subcategories:

- quantification and specification of problems
- scale and intensity of the problem
- its incidence,
- characteristics,
- target ability,

- scope,
- rate of change,
- uncertainty, and
- availability and relevance of existing programme.

Policy studies are complete only if the characteristics and dimensions of the problems are considered (Dye as cited in Gerston, 1997). The decline in the quality of milk becomes an issue of concern with regard to appropriate action that is necessary to solve the problem (Anderson, 2000: 87-93). Dye (as cited in Gerston, 1997) and Etzioni (as cited in Parsons, 1995) advocate an analysis not only of the policy problems but also of the policy options or solutions to these problems.

b) Policy Advocacy

Smith (as cited in Wissink, 1999) proposes the advocacy of policy as the advocacy of policy issues or choices and persuading the superiority of a particular policy choice. Policy advocacy is one of the activities for an analysis for policy approach. Other activities involve the information for policy action and policy monitoring and evaluation (Wissink, 1999:61). This action should be clear and attainable to achieve success when implemented.

2.4.4 Policy Formulation

Lindblom (as cited in Rist, 2005) states that policy makers have to identify and formulate their problem as they are not faced with a given problem. Policy formulation encompasses an attempt to isolate the questions or issues involved. At the policy formulation stage, information revolves around the understanding of the policy issue at hand. This *inter alia* involves:

- the context within which these issues are to be resolved,
- clarifying the objectives,
- discovering the major factors that are operative, and
- getting some feel for the relationships among them.

Mutahaba (as cited in Cloete & Wissink, 2000) regards policy formulation as encompassing problem identification, data and information generation and analysis, and decision making. Rist, (2005:4) suggests that information needs are highly relevant for the policy formulation phase before conducting any analysis and are generally clustered around three broad sets of questions. For Mutahaba the first stage cluster of questions revolve around an understanding of the policy issue at hand and consist of:

- Contours of the Issue - Is the problem or condition one that is larger now than before, or about the same or smaller? What are the different interpretations and understandings of the condition, its causes and its effects?

Lindblom (as cited in Rist, 2005) stated that policy makers had to identify and formulate their problem as they are not faced with a given problem. They have to find out what is known about the nature of the condition, whether it can be measured, what the different interpretations and understandings as well as the causes and effects of the condition are. The second cluster of questions focuses on what has taken place previously in response to this condition or problem. The questions considered here are:

- Previous responses towards problem condition - What is required is knowledge of what prompted the policy or programme response in the first place? What programmes or projects had previously been initiated? How long did they last? How successful were they? What level of funding was required? Did the previous efforts address the same condition or problem as the current one, or was it different? If it was different, in which way did it differ? If it was the same, why are yet more efforts necessary? Are the same interest groups involved? What may explain any changes in the present interest group coalition? The third cluster of questions relevant to the policy formulation stage focuses on:

- Previous efforts and their impacts - What efforts were made by the organisation or institution to respond to the initiative?

Considering trade-offs among various levels of effort in comparison to different levels of cost is but one among several kinds of data relevant to considering the policy options. Furthermore, for Rist (2005:6), the key issue among the activities in the policy formulation stage is the selection of the most appropriate policy strategy and the selection of suitable tools.

2.4.5 Policy Decision

Hogwood & Gunn (1984:19) argue that public policy is larger than a decision and involves a series of more specific decisions. In Chapter 5, specific decisions or programme initiatives of the WCDM to control milk safety at the point of production is analysed. The nature of the problem and what constitutes a solution may depend on the decision level at which it is considered (Miyakawa, 1999:229-230). Although the policy path is aimed at the achievement of goals, some policies are not met in their entirety. Consultation with stakeholders, negotiation and mandated decisions not only contribute to the policy decision process but also the public agenda.

2.4.6 Policy Dialogue

Public policy dialogue is defined as the interaction between governments and non-governmental organisations at the various stages of the policy development process to encourage the exchange of knowledge and experience in order to have the best possible public policies. Good practice of policy dialogue involves engaging in an open, inclusive and ongoing dialogue through the various stages of the public policy process. This includes issue identification, agenda-setting, policy design, implementation, monitoring and impact assessment (Ali-Dinar, 2002). Continuous dialogue with policy makers ensures that policy products are locally owned, relevant and responsive to local policy needs, not only in disseminating policy findings, but also when designing and implementing policy projects.

2.4.7 Policy Implementation

Policy implementation involves policy communication, administration, testing and follow-up as part of this process. According to Parsons (1995:466), the implementation of policies fails when policy objectives are not met. This may be due to factors such as the selection of the wrong strategy, or wrong machinery or instruments being used; programming by the bureaucracy being incorrect; operationalisation being poor; or poor response to problems. Cloete, Schlemmer & Van Vuuren (1991:16) have indicated that a lack of resources, unclear objectives and unexpected consequences are obstacles to effective policy implementation. Sabatier (as cited in Parsons, 1995) proposed a model of empirical research that synthesises both a top-down and bottom-up approach towards effective implementation of legally stated policy objectives comprising:

- Clear and consistent objectives, to provide a standard of legal evaluation and resource;
- Adequate causal theory, thus ensuring that the policy has an accurate theory of how to bring about change;
- Implementation structures that are legally structured so as to enhance the compliance of those charged with implementing the policy and those groups who are
- the target of the policy;
- Committed and skilful implementers who apply themselves to using their discretion so as to realise policy objectives;
- Support of interest groups in the legislature and executive;
- Changes in socio-economic conditions that do not undermine the support of groups or subvert the causal theory underpinning the policy

The researcher is of the opinion that the implementation strategies for controlling milk safety are not effective. The specific question asked in this study is about how successful the implementation of the milk safety control strategy is at milking sheds to assure a) that milk of sound bacteriological quality is produced, and b) that milking sheds comply with legislative standards. For that reason, in Chapter 5, policy decisions contributing towards the strengthening of the milk safety control strategy for milking sheds are analysed. The success gained with the implementation of any policy programme is measured through processes of monitoring and evaluation. These are discussed in the next section.

2.4.8 Monitoring and Evaluation

According to Miyakawa (1999:136), monitoring and evaluation take the form of *ad hoc* analysis of policies and programmes. In this section monitoring and evaluation will be discussed under separate headings.

a) Monitoring

Monitoring involves a planned sequence of observations or measurements of critical limits designed to produce an accurate record and intended to ensure that the critical limit maintains product safety. Continuous monitoring provides an uninterrupted record of data (FDA/CFSAN, 2001). Monitoring policies or procedures comprise efforts that include the

observation and evaluation of existing policies and procedures. Four elements of quality control are proposed as solutions to monitoring (Reyl, 2001:1):

- Relevance and Adequacy of Policies and Procedures
- Appropriateness of Guidance, Materials and Practice Aids
- Effectiveness of Professional Development Programmes
- Compliance with Milk Policies and Procedures

Inputs, activities and processes of monitoring programmes are more likely to be subject to evaluations for accountability, including programme impact. Monitoring programmes are successful when intended targets are reached, planned services are provided, they are cost-efficient and legal responsibilities are met (Shadish, Cook & Leviton, 1991:404,405).

Monitoring is required of the way resources are used and activities carried out. It is also seen as the day to day following of activities during their implementation, makes it possible to identify deviations, measures progress over time, identify variations between programmes (WHO, 1989).

Inconsistency of monitoring procedures when administering control over milk quality could, however, lead to disparate success. This inevitably clashes with any appropriate strategy and may cause confusion. The nature of such policies therefore needs to be revised to guarantee a uniform and consistent approach to achieve common goals.

b) Evaluation

Different tools are applied to evaluate programmes. The evaluation of outcome, chosen as measuring tool, cannot expect good outcomes without effective implementation (Posavac & Carey, 1997:7-10). Evaluation literature in public policy is for the most part concerned with the evaluation of programmes and policies (Parsons: 1995, 545). Hence, the purpose of any evaluation is to distinguish between effective and ineffective policies and programmes. Daneke & Steiss (as cited in Miyakawa, 1999) view the focal point of policy evaluation as the development of measures and methodologies of comparison. They have summarised these basic methods of comparison as:

- Before vs. After Programme Comparisons

- Time Trend Projections of Pre- and Post programme Data
- With and Without comparisons
- Controlled Experimentation
- Comparisons of Planned vs. Actual Performance

The method of evaluation chosen for this thesis is the Time Trend Projections of Post Programme Data. Parsons (1995: 543) has stated that evaluation has two interrelated aspects:

- The evaluation of policy and its constituent programmes; and
- The evaluation of people who work in the organisations that is responsible for implementing policy and programmes.

Evaluation research addresses two dimensions (Parsons, 1995: 545,550):

- How a policy may be measured against a goal it sets out to attain; and
- The actual impact of the policy.

According to Lammerding & Paoli (1997:1), the food supply requires new strategies for evaluating and managing food safety risks. They point out that risk assessment offers a framework for predicting the impact of changes and trends in the provision of safe food. They also indicate that risk assessment models facilitate the evaluation of active or passive changes in how foods are produced, processed, distributed, and consumed. Furthermore, they have proposed quantitative risk assessment as an approach for designing programmes to address emerging food-borne diseases.

2.5 Conclusion

In this chapter public policy was described as complex, a response to policy demands, as the conduct of public affairs and purposive courses of action, and a policy issue analysis was identified as the approach to the analysis of policy. The bacteriological quality control of milk and milk production provides the constructs on which the analytical approach is based. The generic process model was employed as methodology to assist towards solutions for the policy issue. This model focuses on policy process initiation, policy process design, policy analysis, policy advocacy, policy formulation, policy decision, policy

dialogue, policy implementation and, finally, monitoring and evaluation. This approach consists of two subsections namely policy problem structuring and policy advocacy that serve as analytical tool. Policy advocacy promotes the best policy choice as an alternative policy option. In concluding this chapter, the process of evaluation distinguishes between effective and ineffective policies.

The implementation of the policy issue has therefore to be set in the context of types of policies and political priorities but also in terms of inter-organisational relationships. The operative factors of implementation are change, control and compliance. It is clear that monitoring should be an integral part of any evaluation process and should be introduced into any policy design phase. However, new approaches are required to evaluate and manage food safety risks for food supply as well as for food safety. Risk management and risk communication are proposed as approaches for designing programmes for emerging food-borne diseases.

CHAPTER 3

MILK SAFETY CONTROL

3.1 Introduction

In the preceding chapter the policy issue analysis approach was shown to consist of a problem-structuring phase, defining alternative solutions to the policy problem and forecasting their individual effects and impacts (Cloete & Wissink, 2000:73). In this chapter the essence of the policy issue, being milk safety control, is further structured and analysed within the general theoretical framework. Proposed policies on milk safety control during milk production are considered for this framework.

Food safety are controlled by health authorities by ensuring that food consumers are exposed to does not cause them any harm (Food Control Directorate, 2000). Referring specifically to milk, the connotation to milk safety control signifies the same. The WCDM milk safety control strategy for milking sheds is evaluated for its performance with regard to hygienic control obtained during milking. In the present chapter the impact of this strategy is determined.

3.2 Historical Overview

The epidemiological impact of contaminated milk can be disastrous to man and to the public health as a whole. Science has aided in the development of methods and in obtaining information concerning the true character of milk and its products. Outbreaks of milk-related diseases accentuate the importance of controlling milk safety. Pasteur reported lactic fermentation in 1857 and also stimulated research regarding the relationship of bacteria to disease. The supply of safe milk products are ensured by pasteurisation and other processing technologies that inhibit the growth of bacteria. The early twentieth century has witnessed the risk of food borne diseases with milk-borne transmissions of tuberculosis and salmonellosis. Effective management of microbiological hazards are accentuated with outbreaks involving *E. coli* 0157:H7 in 1979 and the rapid spread of *Salmonella typhimurium DT 104* in the 1990's (WHO: 2002). Controlling microbiological hazards is synonymous with hygiene control. The following section

provides an outline of the importance of effective hygienic control that is discussed under the section 3.3.

3.3 The Hygienic Control of Milk

Given the historical outbreaks of milk-related diseases, contaminated milk poses a risk to public health. Non-compliance with regulations governing milk production is of great concern to local authorities' whose primary duty is to safeguard public health. It should be noted that a detailed discussion of microbiological hazards do not fall within the scope of this research however in section 3.3.2 only Brucellosis and Tuberculosis are discussed.

Milk provides an ideal medium for the growth of micro-organisms in the absence of appropriate safety strategies. Hui (1992:3) views safety issues concerning bacterial control and sanitation in the dairy industry as the primary concern of EHPs.

Hygienic control of fluid milk is necessary to provide the public with a safe, wholesome, high-quality beverage. Rice as cited in (FAO/WHO: 1962) identifies hygienic control measures related to the handling and processing of milk in the dairy industry as involving:

- Milk control on reception
- Hygienic control of raw milk
- Hygienic control of dairy equipment
- Health control of dairy workers.

Environmental conditions can contaminate milk during any stage in the milking process and thus cause bacterial levels to increase in milk. The bacteriological control of milk is essential throughout the milk production process, and therefore is discussed under a separate heading in Section 3.3.1.

3.3.1 Bacteriological Control of Milk

The microbial content of milk is a major feature in determining its quality (Spreer, 1998:6). The types of bacteria that are commonly looked for in milk are indicated in Annexure 1. Milk quality is described as the cyto-bacteriological (somatic cells and bacteria) features, its chemical analysis and organoleptic characteristics (Landbouweekblad, 1986:48). This

thesis focuses attention on the bacteriological quality of milk only. Spreer (1998:51) has suggested that raw milk quality is to be determined by means of the following characteristics:

- Level of nutrients and reagents
- Chemical-physical characteristics
- Level of total plate count and composition of the flora, i.e., level of spore formers coliforms, psychrotrophs and thermo resistant micro organisms in the total plate count, as well as the level of somatic cells (cell count)
- Presence or absence or pathogenic organisms such as those thatt cause tuberculosis, brucellosis or mastitis
- Presence or absence of deleterious substances such as inhibitors or other foreign substances
- Taste and flavour
- Cleanliness of milk

Selected milk quality tests, indicated in Annexure 2, are used to detect certain types of bacteria. Bacteriological testing for milk quality has two main objectives (IDF Bulletin, 1991). These involve determining whether the bacterial content of the milk received at the dairy renders it fit for processing through;

- Assessing the hygienic standards of milk production and milk storage on the farm.
- Cooling.

Bacteria pathogenic to man are found on the udder, in the environment, on personnel, as well as on equipment used in handling milk. The sources which harbours these bacteria and indicated in Annexure 3. Milking must be done in such a way that the quality of milk is not compromised. Therefore farmers should be aware of the sources of milk contamination and understand how they can be controlled. An understanding of the different sources of microbial contamination could assist in identifying possible ways to control contamination during milk production. According to Spreer (1998: 6), the microbial content of milk comprises a major feature in determining its quality. Milk quality is measured against the standard criteria given in Annexure 4, which serve as indicator for this research. The milk quality standards for raw milk for human consumption determine the compliance level for

human consumption. In this regard, to Harding (1995:40) the factors that influences the bacteriological quality of milk is:

- The total number of organisms including the psychotropic organisms in the milk sample, as well as
- The time and temperature of storage at the dairy.

Micro-organisms (mainly bacteria) find access to milk due to their optimum temperature for growth and heat resistance. Harding (1995:44) and Pelczar, Michael, Chan & Krieg (1986:621) classify these as low temperatures that are used to prevent changes due to micro-organisms. High temperatures (pasteurisation) are used to reduce the microbial population, destroy pathogens, and improve the keeping quality of milk. These include psychrophiles with low temperatures of 0-15 °C; mesophiles with medium temperatures of 20-40 °C and thermophiles with high temperatures of 45-55 °C. Psychotropic bacteria are killed by pasteurisation. However, enzymes produced by them can survive to germinate and grow in the pasteurised milk (Heeschen as cited in Gravert, 1987).

3.3.2 Microbiological hazards

The communicable diseases, Brucellosis and Tuberculosis, which are common amongst milk cows, are discussed. Milk containing these microbiological hazards is hazardous to man. Legislation requires the certification of milk cows from communicable diseases before milking for commercialisation (R1555/1977).

a) Brucellosis-Brucella spp.

Brucellosis are caused by all three species of Brucella (Br. melitensis, Br. abortus and Br. suis) that can directly infect man through contact with infected tissues and discharges, or inhalation of dry infected materials. Brucellae are excreted in the milk of dairy animals and are conveyed into raw milk products made without heat treatment. The vaccination of animals may protect against abortion, but it does not prevent mild and sub-clinical infection in which virulent Brucellae are still excreted in the milk. Therefore, the basis for the control of brucellosis world-wide is not vaccination, but eradication of infected or serological positive animals (Gravert, 1987:211-212).

b) Tuberculosis-Mycobacterium tuberculosis.

Milk consumed raw is the principle vehicle for transferring the tubercle bacilli, from infected milk cows to man. The incidence of bovine tuberculosis infection in man depends largely on its presence in cattle and on the amount of raw and inadequately heated milk consumed by the population. Pasteurisation markedly reduces the incidence of bovine tuberculosis in man (Gravert, 1987:216).

Exposures to tuberculous cattle, ingestion of unpasteurised milk or dairy products, and sometimes by airborne spread are the causes of bovine tuberculosis (Benenson, 1990:459)

3.3.3 Milk Production

Hygienic milk production has to ensure that safe, wholesome, high quality milk is obtained through the maintenance of hygienic standards during milk production, processing and distribution (Barber as cited in FAO/WHO, 1962).

Conditions on farms that prevail during milk production can affect the bacteriological quality of milk (Varnam & Sutherland, 1994:96). Inadequate pasteurisation, poor manufacturing practices, and post-processing contamination have been the primary causes of pathogenic contamination in dairy products (Heeschen as cited in Gravert, 1987).

The approach towards quality milk production has to include the cows and the environment, the man and his milking procedures, and the milking equipment and its function. In this regard Johnson (1995:2) has shown that proper milking habits are significant for milk quality. Spreer (1998:51) describes the milking process as a discharge of milk from the udder, either manually or mechanically, wherein the pressure effects (suckling) of the newborn calve is imitated.

MILKING PROCESSES	MILK PRODUCTION PRACTICES		
Pre-Milking	Stimulation of teats Milkier should wear gloves Use strip cup Wash teats with sanitising solution Pre-dipping Cleaning and sanitising gel	Moving of cows Mastitis detection Dry teats thoroughly Udder preparation Cleaning and sanitising gel Pre-dipping	Fore-stripping Sanitising teat surface (pre-dipping) Drying of teats with individual paper or towel
Milking	Milking routine Handling of milking unit Removing milking unit from cow	Attachment of milking unit Removal of milking unit	Attaching milking unit to teat
Post-Milking	Teat dipping Dipping or back flushing milking units Milk *Staphylococcus aureus* Infected or mastitis-treated Cows separately or last	Teat dipping Back flushing Detachment of milking unit	Teat dipping

Table 2: Milking Processes: Johnson (1995) Jones (1998) Bray & Shearer (1996)

Hygienic practices are vital for the milking process. Bray & Shearer (1996:1-4) have written about the importance of the milking process consisting of proper milking procedures. Jones (Publication no. 404-227, 1998) regards proper milking practices and routine to include pre-milking procedures, milking and post-milking.

In the preceding section mention has been made of how easily bacteriological contamination can occur. This indicates the importance of following proper milking practices and processes.

3.3.4 Milking Process

The hygienic control of fluid milk involves many carefully controlled steps that are concerned with the:

- The health of the cow,
- The health of the personnel,

- The condition of the farm,
- The milking operation and equipment,
- Delivery of the milk to the dairy,
- Processing of the milk and eventual delivery to the home.

The above steps are part of the milk production process. These processes are not linear in nature due to the impact one process or activity may have on another process and thereby contributes to the complexity of milk control. The likely risks of contamination of the different processes may indicate on precarious practices and deficient control measures. It is in this regard that stringent control is advocated. The emphasis of milk safety control is on the hygienic control of milking; however it is nonetheless important to institute processes and practices that are harmonious with sound food safety principles that would be ascribed to as effective control measures.

The policies and strategies that were implemented by the Environmental Health Unit should advance the system of quality control. Quality control is an important aspect of hygienic control and discussion of this is deemed necessary.

3.4 Quality Control

Traditionally, the quality and safety of milk and dairy products is evaluated in terms of the presence or absence of certain micro-organisms in raw or finished products. The traditional quality control programmes have emphasised inspection and end product testing to determine compliance with standards, specifications, and regulations pertaining to milk and dairy products. The need for clarity concerning quality control is discussed in this section with reference to compliance for the sake of milk safety relating to its bacteriological quality. It is also discussed with reference to regulatory compliance in terms of applicable legislation.

Quality control is seen as a tactical function that carries out those programmes identified by quality assurance for the attainment of the quality goals (Hui, 1992:3). These programmes involve testing plant hygiene and product quality. Quality control practices vary from rapid platform tests to more sophisticated microbiological quality tests. The quality control activities for milk are determined in terms of quality characteristics and

influences on quality. These quality activities are listed according to Siirtola (Quality Control Manual, 2000) as the:

- Quality of raw materials, ingredients, additives used in processing;
- Control of standardisation, i.e., fat content or raw milk for production of various products;
- Quality and activity of dairy cultures (lactic acid starters), rennet;
- Hygienic quality of packaging materials;
- Quality and strength of cleaning and sanitation solutions;
- Hygienic status of processing line, milk tanks, pipe line and packaging machines;
- Overall cleanliness and hygiene during reception, processing, storage and distribution;
- Organoleptic, hygienic, chemical and physical qualities of the end products including packages;
- Keeping quality properties (shelf life) of end products;
- Well-organised recording of test results and findings, as well as regular and timely reporting.

Quality standards are the elements of quality control and include aspects pertaining to milk bacterial levels in units/cm3, cell count in units per cm3, freezing point in °C, and inhibitors like antibiotics (penicillin) in mg/cm3. In addition, it is vitally important to ensure that the quality standards of production and the commercialisation of raw milk, heat-treated milk and dairy-based products comply with legal requirements.

Internal assessments or quality control should be included at critical points during the milk production process. This should also include the monitoring of important process activities by personnel delivering the service. Dale (1999:6) has indicated that there will have been some development from basic inspection activity in terms of sophistication of methods and systems, self-inspection by approved operators, use of information, tools and techniques that are employed. The final evaluation of the finished product is determined by how well the product meets the quality standards set by controlling agencies like municipalities (Barber as cited in FAO/WHO, 1962). The Hazard Analysis and Critical Control Points (HACCP) is an integral part of the Total Quality System (TQS), Total Quality Management (TQM) approach and have been used for assuring the safety of food products. This system includes the quality characteristics, programmes, steps and activities. In addition to this,

the United States Department of Agriculture (USDA) has identified seven HACCP principles (USDA/FSIS: 1999):

- Conduct hazard analysis
- Determine Critical Control Points (CCPs)
- Establish specifications for each CCP
- Monitor each CCP
- Establish corrective action to be taken if a deviation occurs at a CCP
- Establish a record-keeping system
- Establish verification procedures

Effective management of microbiological hazards is enhanced through the use of tools like Microbiological Risk Assessment (MRA) and Hazard Analysis and Critical Control Points (HACCP) Systems. This is a prevention-based systematic approach to dealing with anticipated food safety problems (Kvenberg, Schwalm & Stingfellow as cited in FAO, 1994). To implement effective milk safety control strategies for milking sheds indeed requires an effective management tool from which policies can be formulated.

Risk assessment comprises of four steps. These are hazard identification, exposure assessment, dose-response assessment, and risk characterisation. Each step represents a cause-and-effect chain reaching from the prevalence and concentration of the pathogen to the probability and magnitude of health effects (Lammerding & Paoli, 1997). When these four steps are addressed, risk assessment basically provides answers to the following three questions: What could go wrong? How likely is it to happen? What would be the consequence if it did happen? The output of risk assessment may be expressed in terms of the number of humans experiencing specific adverse events over the same period of time (Health Canada, 2000).

Risk Management processes selects the most appropriate option to satisfactorily deal with the health risks while considering the impact of such decisions. However, Risk Assessment estimates the health risks associated with the scenario being evaluated. Risk Communication occurs throughout the process to ensure appropriate involvement of stakeholders at various steps in the process (Health Canada, 2000).

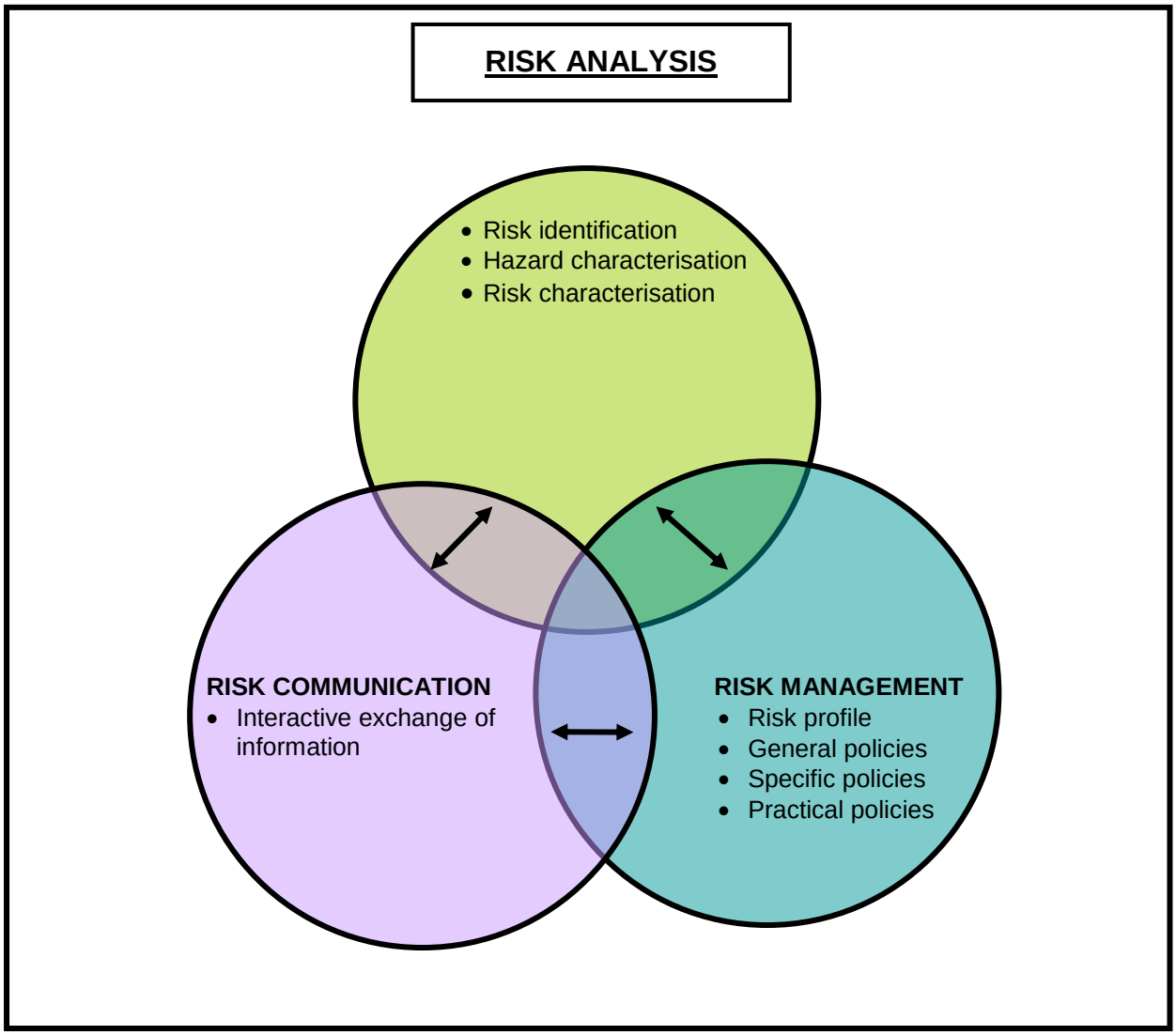


Figure 3: Schematic Diagram of Risk Analysis (Canadian Food Inspection Agency)

3.5 WCDM Milk Safety Control Strategy for Milking Sheds

It should be noted that the milk safety control strategy determines the processes that were followed by the Environmental Health Unit. The planning mode describes strategy as a plan or explicit set of guidelines developed in advance. In this regard a systematic and structured plan as well as the direction of the plan is identified (Robbins, 1990:121,122).

Food safety policies that endeavour to control the hygiene and safety of milk during milk production seemed inevitable to consider for this thesis. The WCDM is challenged to strengthen the current milk safety control programme which primarily relies on the regular testing for microbial quality as part of a strategic component of monitoring milking sheds. The milk control strategy of the HDCCT focused mainly on the side of sampling. It

therefore appear that milk control is not related to the point of production, so it seems that the current approach only promotes a specific practice for controlling milk safety. The constitution and the execution of these policies are cardinal. Policies should evaluate and assess whether action in progress are in line with policy principles to achieve effective milk safety control.

3.6 Conclusion

In the light of food safety, hygienic standards for food premises should not be compromised. In this regard, management commitment is indispensable for milking sheds to achieve quality standards and quality assurance during milk production.

Strategic intervention is essential and should measure whether the bacteriological quality of milk complied with the requirements for legislative standards; also it should evaluate whether the impact of strategy could indeed assure the safety of foodstuffs.

The hygienic control of milk should prevent the contamination of milk from any possible source. Considering this, makes quality control essential for the milk production process. Obtaining quality milk products are likely when aspects of hygiene are linked to elements of quality control.

CHAPTER 4

POLICY AND REGULATORY FRAMEWORK

4.1 Introduction

This chapter discusses food safety control legislation within the context of a policy and regulatory framework. Subsequently, the international, national and local views on milk safety are examined. Firstly, at international level, this study is informed by food safety policies as postulated by organisations like the World Health Organisation (WHO) and the Food and Agricultural Organisation (FAO). Furthermore, with specific focus on milking at milking sheds, policies of the national government as it pertains to food control and food safety is analysed. In addition, local authority policies, in this case study the WCDM, are also analysed. EHPs do inspections and monitor milking sheds according to these policies to ensure that hygienic conditions for milk production prevail.

4.2 International Organisations

The globalisation of the food trade resulted in the introduction of international standards. The establishment of the Joint FAO/WHO Food Standards Programme, with the Joint FAO/WHO and the Codex Alimentarius Commission (Codex) as its principal organ, and with the inclusion of the World Trade Organisation (WTO), has adopted many international standards on food safety. (WHO: 2002).

The objective of Codex was designed to develop standards for food moving in international trade, in order to safeguard public health, and to ensure fair trading practices. The international food safety policies serve as barometer for developing countries, hence for South Africa in particular. This ensures that food safety requirements and quality standards are aligned and are consistent with international requirements. In this regard, and for the purpose of this thesis, only the food safety policies of WHO and FAO are studied to determine what these food safety policies should constitute. WHO's role in food safety is to reduce the burden of food-borne illness by advising and assisting Member States to reduce exposure to unacceptable levels of chemicals or micro-organisms in food (FAO, 1999). In addition to this role WHO also extended its support to Member States by:

- Assisting governments in strengthening health services related to food safety;
- Promoting improved nutrition, sanitation and other aspects of environmental hygiene;
- Developing international standards for food; and
- Assisting in developing informed public opinion among all peoples on matters of food safety.

The joint FAO/WHO and Codex have set standards that require that all health and safety requirements must be justifiable on the grounds of protecting public health and must be based on sound, scientific risk assessment. This strategy advocates broad lines of action and is introduced by the following approaches (WHO: 2002).

- Strengthening surveillance systems for food-borne diseases;
- Improving risk assessments;
- Developing methods for assessing the safety of the products of new technologies;
- Enhancing the scientific and public health role of WHO in Codex;
- Enhancing risk communication and advocacy;
- Improving international and national co-operation;
- Strengthening capacity building in developing countries.

4.2.1 The WHO and Quality Assurance

The Hazard Analysis Critical Control Point (HACCP) is an analytical tool that was adopted by the joint FAO/WHO Codex Alimentarius Commission. This tool enables local authorities to implement a preventative food management system.

The internationally accepted principle that food safety is best assured through the identification and control of hazards in the production, manufacturing and handling of food, is described in the HACCP system. The application of the HACCP system requires food businesses to take greater responsibility for and control of food safety risks (FAO, 1994).

4.2.2 The FAO and Quality Control

Siirtola (2000) proposed the methodology of the FAO/WHO (1998) for the planning and establishment of quality control for a milk plant. This includes:

- Organisation and staffing of the quality control activity within the plant training the quality control personnel;
- Definition of quality standards, taking into account also the legal requirements for raw materials, ingredients, packaging materials, processing line and equipment, end products, storage and handling during distribution;
- Laboratories and methods for testing and analysing the quality parameters, including organoleptic, physical, chemical and microbiological methods – Sampling methods and schedules.
- Alarm limits (maximum/minimum) for quality parameters – Recording and reporting systems.

4.3 The Constitution, (Act 108 of 1996)

The Constitution is the supreme law of South Africa (The Constitution of the Republic of South Africa, Act 108 of 1996, henceforth Act 108/1996). In this regard any law or conduct inconsistent with Act 108/1996 is invalid.

Environmental Health decision making must be consistent with constitutional rights concerning health care, food and water as stipulated in Section 27 of Act 108/1996. In addition, the state must employ reasonable legislative and other measures with the utilisation of its available resources to achieve the progressive realisation of each of these rights. Legislative measures would include measures imposed in terms of national or provincial legislation, or by-laws. Other measures would include policies, plans, and guidelines that are derived there from (EnAct International, 2003).

4.4 The Municipal Structures Act, (Act 117 of 1998)

The Structures Act, (Act 117 of 1998) endorses the constitutional objectives of local authorities, which include the promotion of safe and healthy environments (EnAct International, 2003).

4.5 The Municipal Systems Act, (Act 32 of 2000)

Both the Department of Health and the Department of Agriculture attend to food safety at national level. For the purpose of clarity, a distinction is made between the role of the

national Department of Agriculture and that of the Department of Health. With reference to foodstuffs, the role of the Department of Agriculture focuses on aspects of quality control whereas the focus of the Department of Health is on the safety of foodstuffs. Mention is made in the text of quality control which specifically relates to the control of milk bacteriological quality.

4.6 The Role of the National Department of Health and Food Control

The Environmental Health Directorate has the task of determining norms and standards at national level (Department of Health: 1995). Monitoring of foodstuffs in general is the responsibility of the National Department of Health, but this responsibility in most cases is delegated to local authorities. This delegation involves the authorisation of a "quota" of samples to be taken by local authorities and is analysed by specified laboratories (Derry, 1994:38).

Food safety control measures involve the exercising of duties and powers in terms of the requirements of Act 63/1977 as well as Act 54/1972. The former Department of National Health and Population Development promulgated legislation under the Act 63/1977, to organise and control milk in South Africa. The enforcement of regulations passed under Act 63/1977, as well as regulations passed under Act 54/1972, should ensure the effective control of milk that is safe for human consumption and distribution. This creates a controversy, implying that those milking sheds complying with the above-mentioned legislation necessarily distribute safe milk. Also, that the standards contained in the legislation provide effective policy guidelines that ensure milk products of sound bacteriological quality are produced.

4.7 Food Safety Control Legislation

The Directorate: Food Control, included in the Chief Directorate: Pharmaceutical Policy and Planning of the Department of Health, is directly responsible for all matters related to food safety control at a national level. The Directorate: Food Control administers the Acts that relate to food. However, the main functions of the Directorate: Food Control, inter alia, is to (Food Control Directorate, 2000):

- Administer, compile and publish legislation relating to food safety, food labelling and related matters;
- Initiate, co-ordinate and evaluate general as well as more specific food monitoring programmes;
- Audit and support provinces and local authorities with food law enforcement;
- Inform, educate and communicate (IEC) food safety and related matters to stakeholders such as industry, consumers and other departments;
- Act as the national contact point for the joint FAO/WHO Codex Alimentarius Commission;
- Evaluate agricultural remedies and chemicals and food produced by means of biotechnology.

Only regulations applicable to milk that were passed under Act 45/1977 as well as Act 63/1977 will be discussed in the following sections. This legislation enables a framework from which to construct uniform food safety control policies for milking sheds.

4.7.1 The Foodstuffs, Cosmetics and Disinfectants Act, (Act 54 of 1972)

The Regulations that were promulgated under Act 54/1972 governs the manufacture, sale and importation of all foodstuffs from a food safety control point of view. These Regulations aim at setting minimum standards and requirements with which all foodstuffs should comply. For the purpose of this research, selected regulations that only relate to milk are discussed (Food Control Directorate, 2000).

a) Regulation relating to the Duties of Inspectors and Analysts, (R 2162 of 1973)

The Regulation relating to the Duties of Inspectors and Analysts, R 2162 of 1973 provides for procedures when taking a sample. This includes the notification of sample, handling of sample, offering of sample, preparation of sample, addition of preservative, keeping and transporting a sample and temperature of the sample.

b) Regulation relating to Milk and Dairy Products, (R 1555 of 1997)

The Regulation relating to Milk and Dairy products, R 1555 of 1997, determines parameters for the various laboratory quality tests and sets quality control standards for

indicator as well as pathogenic organisms in milk, and for different categories of milk and dairy products.

With relation to raw and pasteurised milk, this regulation makes provision for the use or sale of raw milk for further processing, sale of raw milk for consumption, raw milk that has become sour and pasteurised milk (RSA, 1997).

4.7.2 The Health Act, (Act 63 of 1977)

Act 63/1977 requires the promotion of a safe and healthy environment. A new Health Act, Act 61 of 2003 that has been promulgated, henceforth referred to as Act 61/2003, stipulates clearly delineated functions for national and local spheres of government. The following regulations that were passed under the Health Act 63/1977 and are in effect under Act 61/2003 until amended will be discussed.

a) Regulations relating to the General Hygiene Requirements for Food Premises and the Transport of Food, (R 918 of 1999)

These regulations are applicable to food premises in respect of the nature of the handling of food, and cover the following aspects related to the above-mentioned regulation:

- Prohibitions on the handling and transport of food
- Standards and requirements for food premises
- Standards and requirements for facilities on food premises
- Standards and requirements for food containers
- Standards and requirements for the display, storage and temperatures of food
- Standards and requirements for protective clothing
- Duties of a person in charge of food premises
- Duties of a food handler

b) Regulations relating to Milking Sheds and the Transport of Milk, (R 1256 of 1986)

The Regulations relating to Milking Sheds and the Transport of Milk, No. R.1256 of 1986, make provision for prohibitions on the production of milk except in an approved milking

shed; the application, conditions and suspension or withdrawal of a certificate of acceptability and provisional certificate of acceptability.

In addition, requirements and instructions for milking sheds, milk containers and milking machines, milk, dairy stock, milkers and handlers of milk, the transport of milk and general provisions are established. With relation to milk production this regulation explicitly requires the following:

- First milk from teat shall be taken as sample to be tested for mastitis;
- Disposal of milk after testing reveals any signs of abnormality in the milk;
- Milking dairy stock separately during the first seven days following parturition;
- Raw milk to be cooled to a temperature of 5 °C or lower within three hours received in the milk room.

4.8 The Role of Local Authorities in Food Safety Control

Firstly, it should be noted that local authorities have a statutory mandate to control foodstuffs. However, individual local authorities should be authorised by the Minister of Health to enforce the provisions of Act 54/1972 within the relevant area of jurisdiction. Secondly, local authorities on district level also have a responsibility under the Health Act, 63 of 2003 (henceforth Act 63/2003) to render environmental health services. Food safety-related regulations passed under Act 63/1977 are at present still in effect under Act 63/2003.

The frequent samplings of foodstuffs, regular inspections, evaluations and monitoring of milking sheds by the WCDM generally suggest that the milk safety control programme is supported. The activities of local authorities related to food safety control generally centre on the following: (Food Control Directorate, 2000)

- Advising existing and prospective entrepreneurs of requirements related to food premises and the safe handling of food;
- Controlling of illegal imported foodstuffs offered for sale within the area of jurisdiction;
- Investigating and introducing appropriate control measures for all incidences of food-borne diseases that come to their attention;

4.9 Enforcement of Legislation by the WCDM

The above-mentioned regulations set compliance standards for milking sheds. A broad spectrum of requirements for milking sheds is covered by legislation. An interview with EHPs revealed that it was felt that milk safety control needs to be a specialised function for an EHP and that sufficient funding should be provided by the local authority for that specific function.

4.10 Conclusion

Standards, policies and principles on food safety and food control that relate to milk safety have been scrutinised. In the national and local sphere of government, the policies, as well as research conducted with regard to the bacteriological quality of both raw and pasteurised milk were analysed. It was stressed that hygienic control during milk production is essential for the public health and cannot be compromised.

Analytical tools that are crucial for control should be employed to identify risks and biological hazards relating to foodstuffs. However without relevant and applicable policies and implementing strategies applying these tools are marked as useless exercises of management that are perpetually operating in the decision mode.

CHAPTER 5

EMPIRICAL ANALYSIS OF THE DATA OF THE CASE STUDY

5.1 Introduction

The objective for this chapter is to analyse the empirical data collected for this thesis and interpret it into meaningful results. This is supported by the literature study that primarily informs this study on food safety and food safety control. With regard to the WCDM, milk sample statistics that were obtained from laboratory reports, interviews with EHPs, reviews of decisions of meetings, and departmental milk policies provided further data for this study. In addition, a structured questionnaire and milk sample statistics provided the data pertaining to the HDCCT informs the analysis of this thesis.

Cloete (CAPAM, 2000) has stated that comparative empirical research increasingly indicates a need to improve strategic decision-making processes in government. This study aimed to exemplify the decision-making processes that were followed with regard to milk safety control. In this chapter, the WCDM policy strategy is evaluated in relation to the policy analysis framework that was discussed in Chapter 2. The policy decisions that were taken by the WCDM will be discussed in this chapter with reference to the milk production processes presented in Chapter 3. The fourth chapter advocates legislative guidelines and requirements, hence providing a regulatory framework for controlling fluid milk. In view of the input of previous chapters, the empirical analyses of the data of the WCDM and the HDCCT are presented in this chapter as case studies.

5.2 Milk Hygienic Safety

The scope of milk hygienic safety is discussed in sections 5.2.1 and 5.2.2 in terms of the milk statistics recorded over a period.

5.2.1 Measurement of the Hygienic Quality of Milk

Harding (1995:49) states that milk with low bacterial count should be produced and the count, by adequate temperature control, should be kept low until processing. The total viable count tends to be a good measure of hygiene. The microbial tests indicated in

Annexure 2, are empirical methods for assessing the milk quality. Historic information is produced since the milk samples are obtained and the results are available. The measurement of milk quality relies on the sample test being representative of the bulk supply from which it was drawn. Prior to the execution of the sample procedure, EHPs should ensure: a) that automatic agitators periodically mixes milk; b) that the temperature of the milk tank from which the sample are drawn are correct. With regard to sampling, the scope of this research is limited to the procedures performed by both the WCDM and the HDCCT. In the case of the WCDM, the sample procedure consisted of the following:

- Measuring the bulk tank temperature prior to sampling;
- Taking of samples in 100ml sterile glass bottles;
- First jets of raw milk may contain water and should not be sampled;
- Sampling of milk emerging from the intake line;
- Keeping milk sample cool when transporting to the municipal office;
- Keeping milk below 5 ºC when transporting to laboratory the following day.

In the case of the HDCCT, the sampling procedure included of the following:

- Measuring the bulk tank temperature prior to sampling;
- Uncovering of plastic bottles at point of sampling;
- Taking of samples in 50ml sterile plastic bottles;
- Using of dipper attached to sterile bottle when inserting into milk tank;
- Sampling of milk from opening on top of tank;
- Keeping milk sample below 5 ºC when transporting to the municipal office;

The WCDM and the HDCCT both exercised different sampling procedures. Admittedly, differences in sampling procedures may likely contribute to the complexity of outcome results.

5.2.2 Microbiological Tests

This section, however, only highlights the significance of bacteria that are commonly looked for in the analyses and the intention is not to give a detailed discussion of the methodology of laboratory quality control tests as such. The milk quality standards for raw

and pasteurised milk that are indicated in Annexure 4 served as parameter for the milk sample analyses.

5.2.2.1 Indicator Bacteria

Section 5.4.1 presents the case of the WCDM and analysis the raw as well as pasteurised milk data for detecting indicator bacteria.

a) The Standard Plate Count (SPC)

The SPC method is an empirical method for assessing milk quality and produces only historic information. SPC is the most widely used test and serves as a general indication that good hygienic conditions were adopted during milk production. It is also called the total bacterial count (TBC), standard plate count (SPC) or total viable colony count (TVC), (Harding, 1995:51).

SPC is usually less when the sanitation is good and cooling is adequate (Jones, 2001). SPC is relatively accurate for determining viable bacteria. It is also used to determine the microbiological quality of raw and pasteurised milk. Act 54/1972, does not allow raw milk to be sold for consumption when the SPC gives more than 50 000 colony forming units (CFUs) per 1, 0 ml of milk. This standard will be used as criterion for analysing the statistics of milk sampled by the WCDM.

b) Coliform Count (CC)

Coliform organisms are gram-negative, non-spore-forming rods that ferment lactose through the production of acid and gas. Positive results on the primary media are considered to be positive presumptive tests (Barber as cited in FAO /WHO, 1962).

The existence of coliforms in dairy products is suggestive of unsanitary conditions or practices during production, processing or storage. Act 54/1972 stipulates that, determined by the Most Probable Number Test, the standard criterion is that not more than 10 coliform bacteria may be present in raw and pasteurised milk.

5.2.2.2 Pathogenic Bacteria

Section 5.4.1 presents the analysis of data obtained from WCDM raw and pasteurised milk for detecting pathogenic bacteria. Similarly, in section 5.4.2, the analysis of the HDCCT pasteurised milk data is presented.

The pathogenic bacteria that are commonly looked for in the sample analysis are, namely, *Escherichia coli* and *Staphylococcus aureus*. Act 54/1972 stipulates that neither raw nor pasteurised milk found to contain any pathogenic bacteria in a 1, 0 ml milk sample, should be sold for human consumption. These standards serve as criteria according to which milk samples for *E. coli* and *Staph. aureus* bacteria will be analysed.

a) Escherichia coli (*E. coli*)

The presence of coliform bacteria, particularly *E. coli*, in food indicates the possibility of pathogenic contamination, polluted water or a breakdown in sanitation. Apart from the major sub-groups of Enteropathogenic or Enterovirulent (EEC) strains of *E. coli*, the serotype O157:H7 Enterohemorrhagic *E. coli* strain is tested for in milk and is recognised as an emerging pathogen (Greyling, 1998: 17).

b) Staphylococcus aureus (*Staph. aureus*)

The presence of *Staphylococcal* bacteria in milk indicates sub-clinical bovine mastitis. The udder is one source of enterotoxinogenic staphylococci. Enterotoxinogenic strains of staphylococci are isolated from healthy humans and these may contaminate milk during production and processing.

The incidence of *Staph. aureus* could indicate on mastitis, with most infections being sub-clinical in nature and are detected by the production of poor quality milk (Ruegg, 2001).

Regulation R1256 of 1986 requires the test for mastitis of the first jets of milk discharged from the teat of the udder prior to milking.

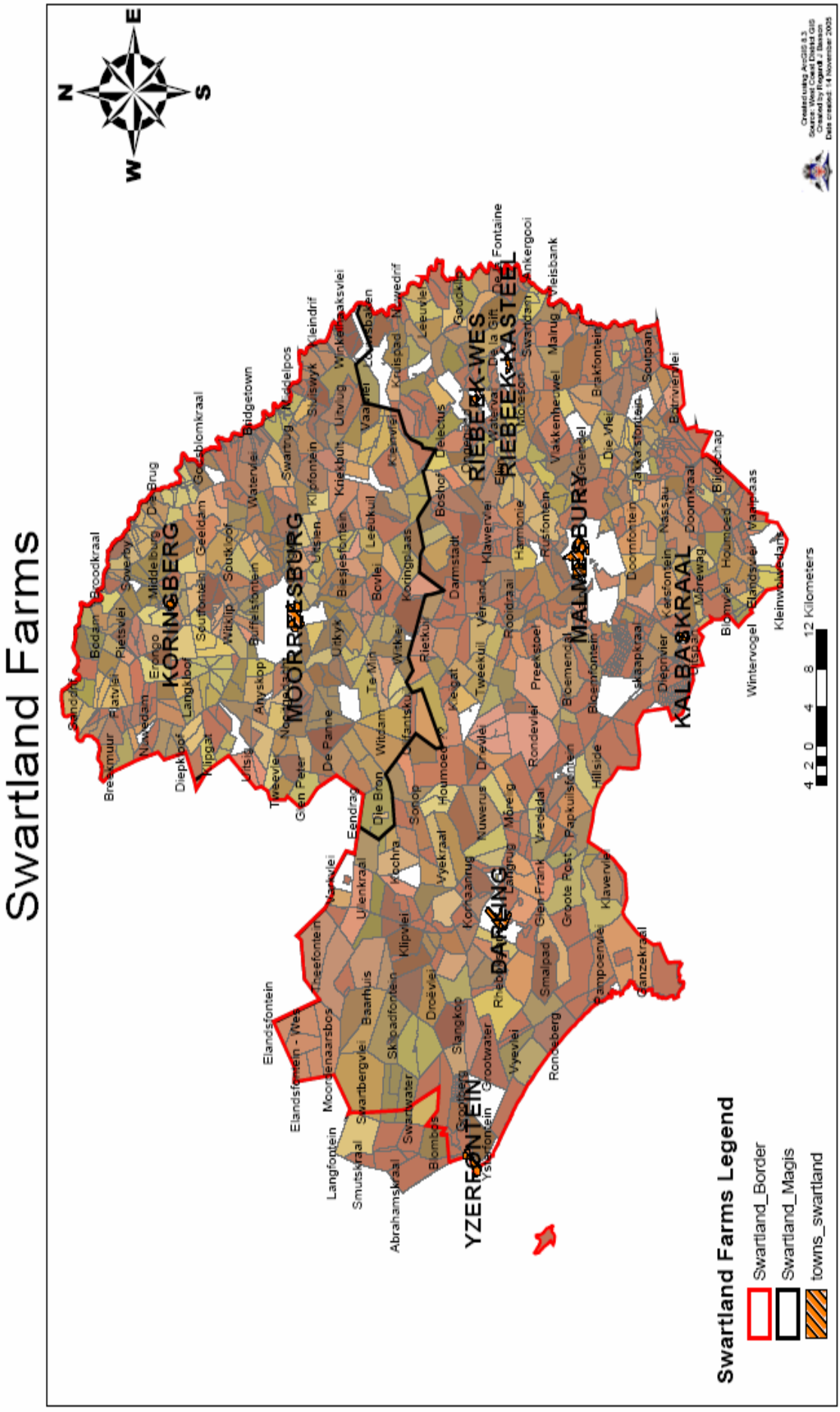


Figure 4, Swartland Farms

5.3 Institutional Framework

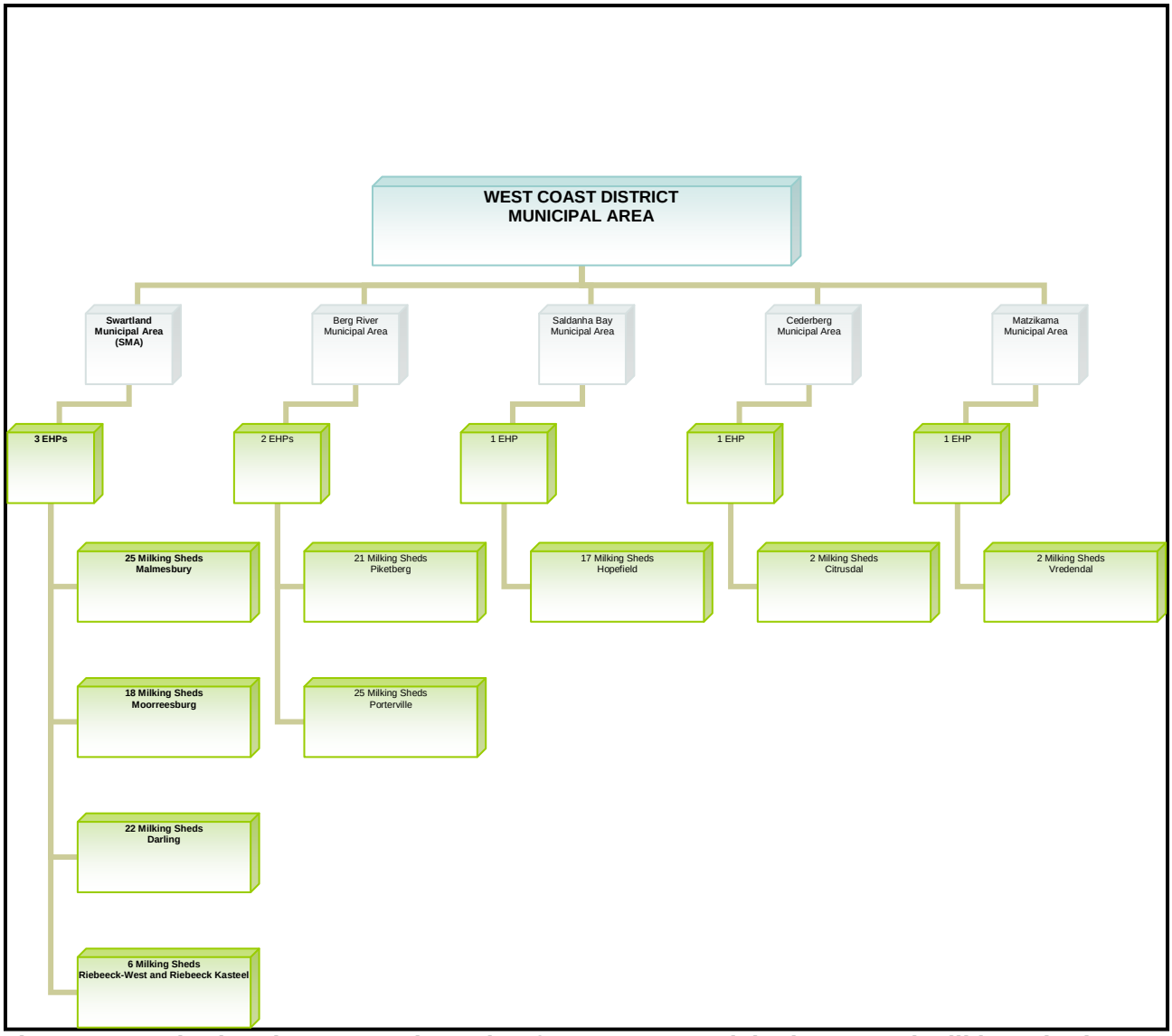


Figure 5: Institutional Framework, Ratio of EHPs per Municipal Area and Milking Sheds

The data for both the WCDM and the HDCCT milk samples were gathered from dairy farms located within the SMA. These dairy farms provided milk, either directly to the public or to milk distributors. The SMA is one of five local municipalities that form part of the West Coast District Municipal Region (see Figure 1). The study is limited to selected Swartland farms located within close proximity of the rural towns of Malmesbury, Moorreesburg, Darling, Riebeeck West and Riebeeck Kasteel (see Figure 4). During the research period, EHPs of the WCDM monitored 16 milking sheds that provided milk to the public. Names of these dairy farms cannot be disclosed, due to the autonomy of this thesis and the ethical considerations attached thereto. The HDCCT focused on 68% of farms located in the SMA, with 56% (15) of farms located in the Malmesbury area; 83% (5) in Riebeek West/Kasteel area; 100% (18) in Moorreesburg area and 50% (11) in the Darling area.

5.4 The WCDM Milk Safety Control Strategy for Milking Sheds

The WCDM strategy consisted of policy mechanisms that included control measures followed and statutory action that were taken.

The HDCCT rendered support to the WCDM with milk safety control with its extended milk-sampling program.

5.4.1 The Case of the WCDM

The WCDM monitored the bacteriological quality of milk via sampling from the farm bulk tank in cases where the regular testing for bacteriological quality lacked prior to the milk being sold by the farmer. Hence, the case of the WCDM is discussed by the analysis of milk bacteriological quality and includes:

- The analysis of raw milk for indicator bacteria;
- The analysis of raw milk for pathogenic bacteria;
- The analysis of pasteurised milk for indicator bacteria;
- The analysis of pasteurised milk for pathogenic bacteria;
- The WCDM sampling results

In addition, the HDCCT milk bacteriological quality sampling results are analysed. This is followed by the analyses of the implementation of the WCDM policy strategies with regard to milk safety control during the research period.

a) The Analysis of Raw Milk for Indicator Bacteria

The indicator bacteria that were analysed for in raw milk samples were viable bacteria and coliform bacteria.

Indicator bacteria generally indicate the presence of pathogens of the intestines that could occur because of direct or indirect faecal contamination (Food Control Directorate, 2003).

- **The WCDM Raw Milk Analysis for Coliform Bacteria**

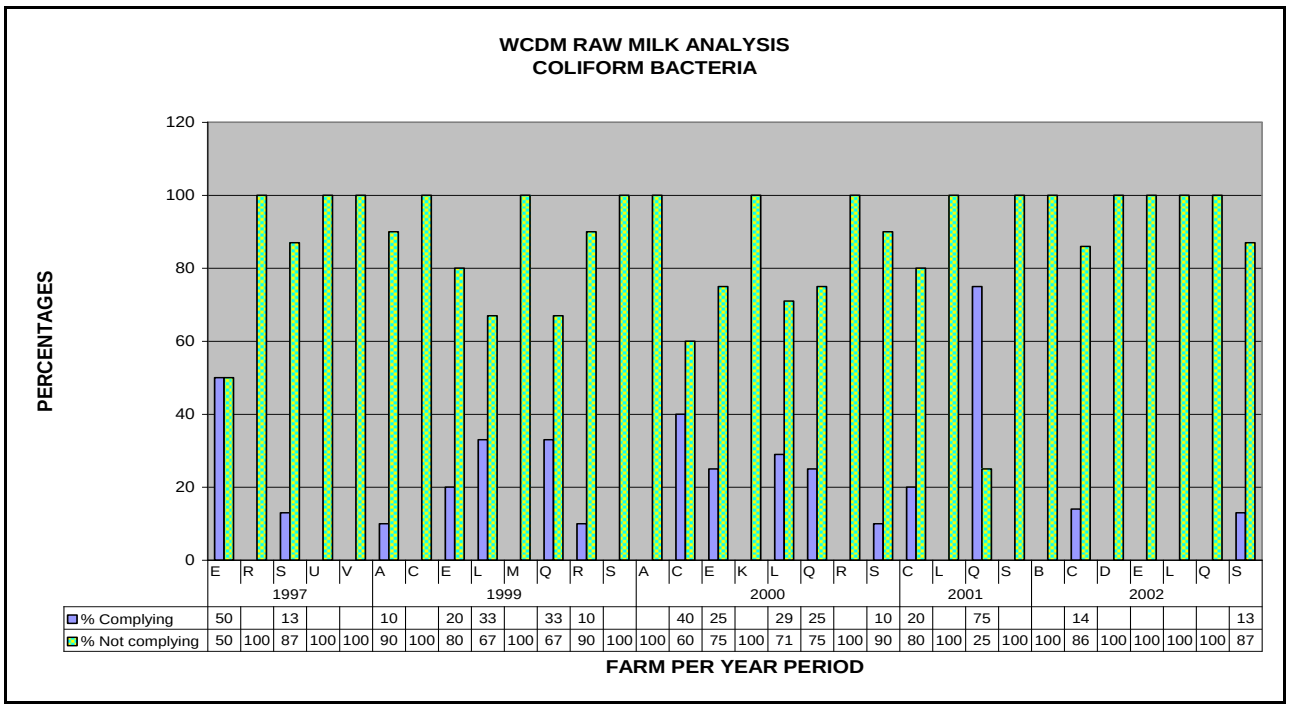


Figure 6: Raw Milk Analysis for Coliform Bacteria per Farm, WCDM Milk Statistics

In Figure 6, raw scores that were not complying with legislative requirements scored 100% (1) for coliform bacteria in 1997 respectively for farm U; in 2000 farm K; followed in 2002, with farm D. In 1999, a 90% (9) for raw scores were obtained respectively for farm A and R; 75% (9) in 2000, for farm Q; 80% (8) in 2001 for farm C, followed in 2002, with 87% (7) for farm S.

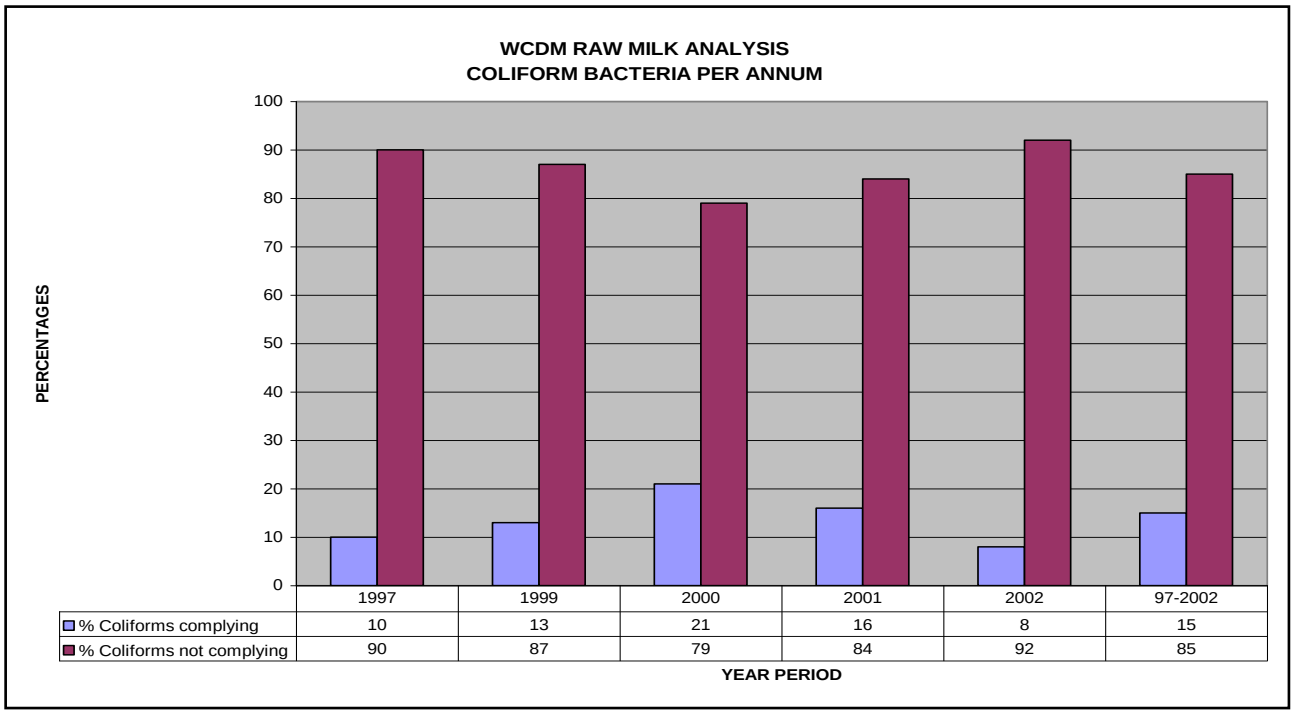


Figure 7: Raw Milk Analysis for Coliform Bacteria per Annum, WCDM Milk Statistics

The incidence of coliform bacteria count that was not complying for raw milk scored 90% (19) for raw scores in 1997, 87% (46) in 1999, 79% (42) in 2000, 84% (26) in 2001 and 92% (23) in 2002.

In figure 7, the coliform bacteria counts were 85% (156) for raw scores that was not complying with legislative requirements during the 1997 to 2002 period.

- **The WCDM Raw Milk Analysis for Viable Bacteria**

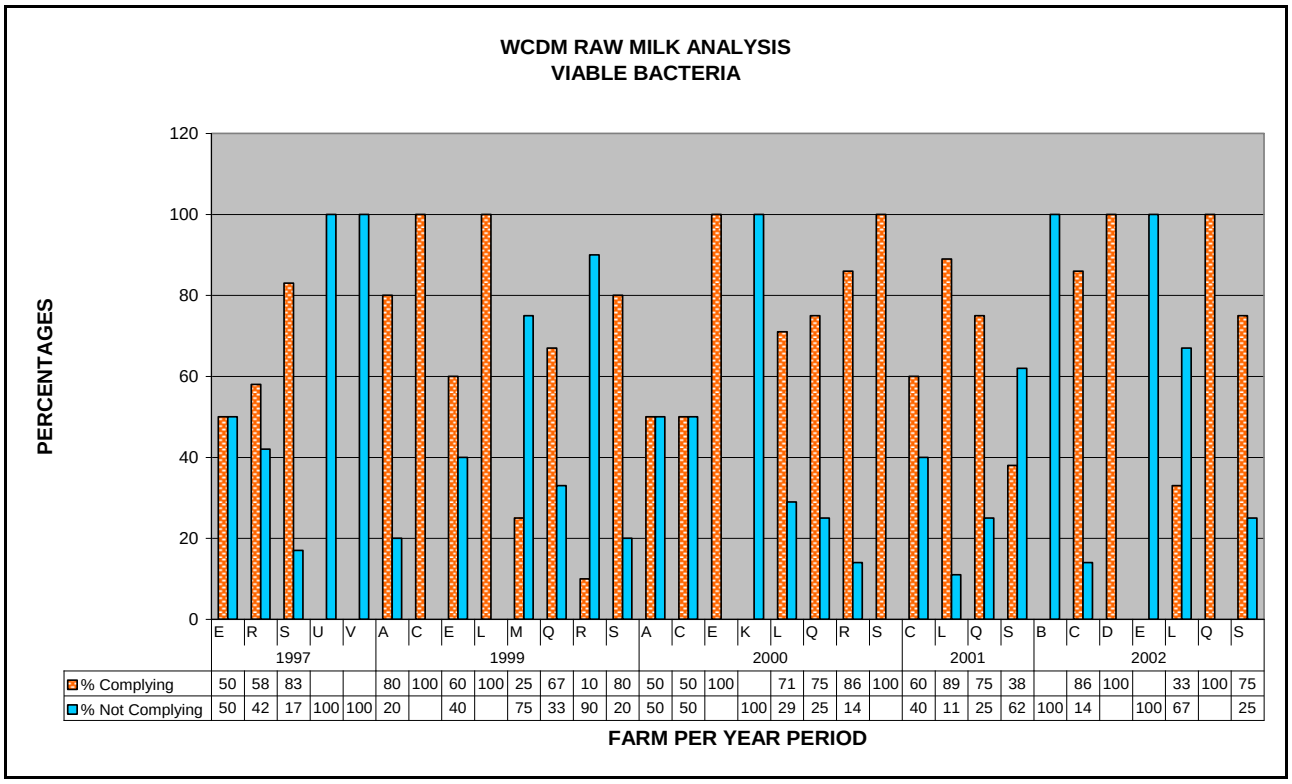


Figure 8: Raw Milk Analysis for Viable Bacteria per Farm, WCDM Milk Statistics

In figure 8, raw scores for viable bacteria that were not complying with legislative requirements scored 100% (1) respectively for farm U in 1997, in 2000 farm K, followed in 2002, with farm E.

The incidence of viable bacteria counts that was not complying for raw milk scored 42% (5) for raw scores during the year 1997 for farm R, 20% (2) in 1999 respectively for farm A and S, 50% (5) in 2000, followed respectively for farm C in 2001, with 40% (4) and in 2002, with 14% (1).

In figure 9, the incidence of viable bacteria counts that was not complying for raw milk scored 36% (10) in 1997, 40% (21) in 1999, 25% (13) in 2000, 35% (11) in 2001 and 36% (9) in 2002.

Viable bacteria counts were 34% (64) for raw scores that was not complying with legislative requirements during the 1997 to 2002 period.

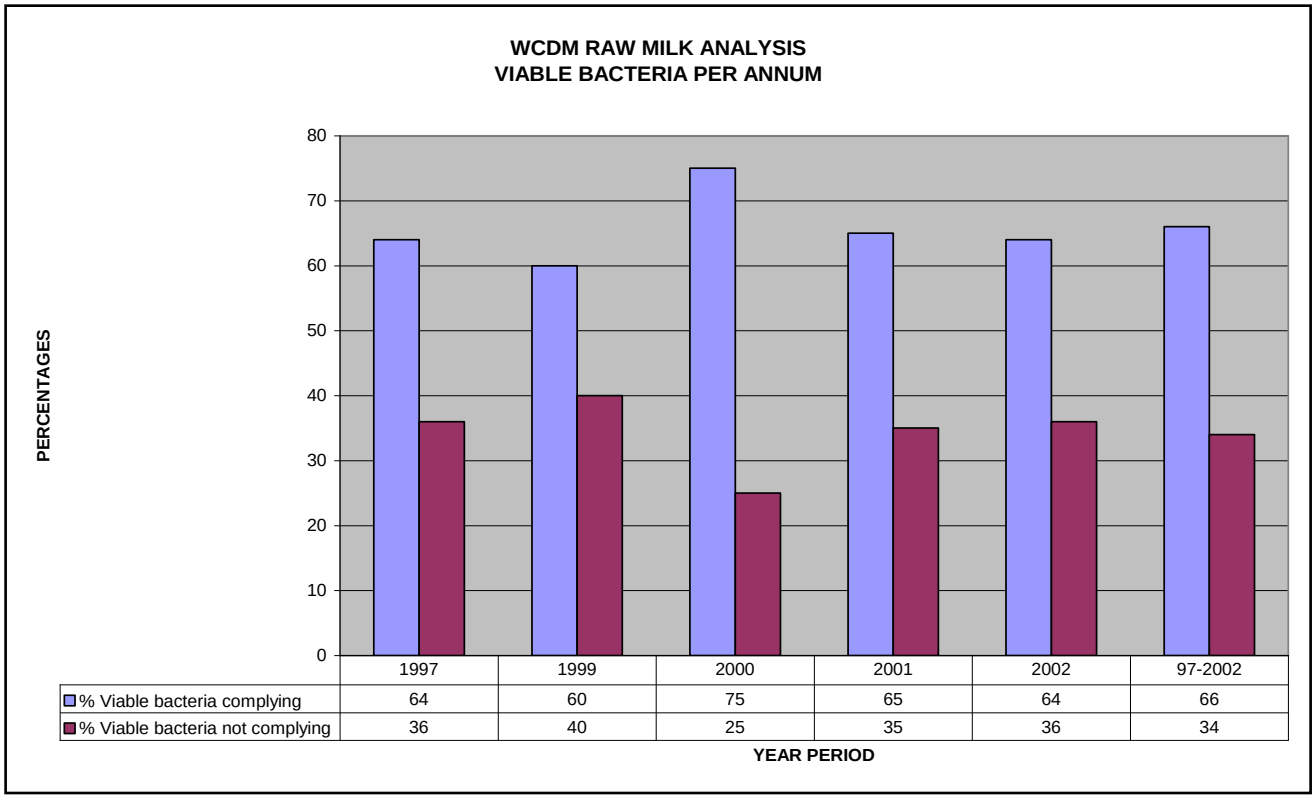


Figure 9: Raw Milk Analysis for Viable Bacteria per Annum, WCDM Milk Statistics

b) The Analysis of Raw Milk for Pathogenic Bacteria

The pathogenic bacteria that were commonly looked for in the WCDM milk samples are *E. coli bacteria* and *Staph. aureus* bacteria.

- **The WCDM Raw Milk Analysis for *E. coli* Bacteria**

In figure 10, raw scores for *E. coli* bacteria that were not complying with legislative requirements scored 100% (1) for farm U in 1997, followed in 2000, with farm K. The incidence of *E. coli* bacteria counts that was not complying for raw milk scored 55% (32) for raw scores during the year 1997 respectively for farm R and S. In 1999, it was 50%

respectively for farm C (1), farm M (2) and farm R (5); in 2000 75% (3) for farm E, in 2001, with 63% (5) for farm S followed in 2002, with 67% (2) for farm L.

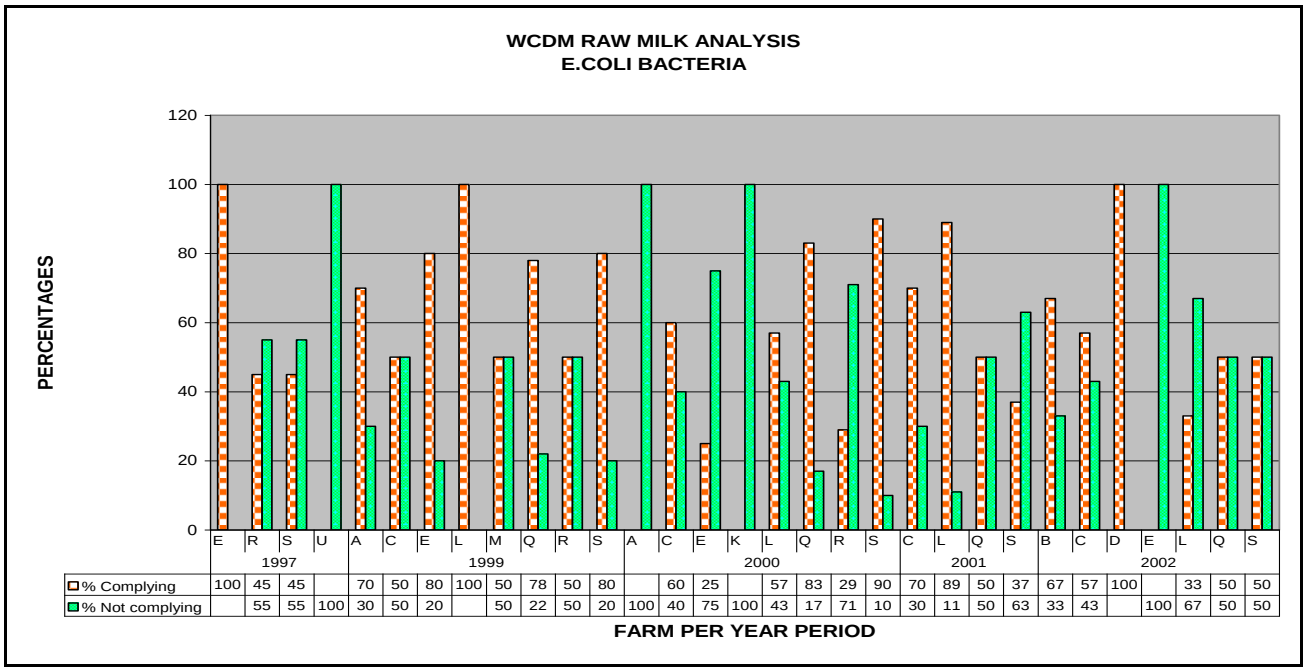


Figure 10: Raw Milk Analysis for *E. coli* Bacteria per Farm, WCDM Milk Statistics

In figure 11, the incidence of *E. coli* bacteria counts in raw milk scored 52% (15) in 1997, 30% (16) in 1999, 40% (21) in 2000, followed with 35% respectively in 2001 (11) and 2002 (12). The total number of samples that did not comply with legislative requirements and rendering milk distributed in the SMA unsafe for human consumption scored 39% (73) for raw scores during the 1997 to 2002 period.

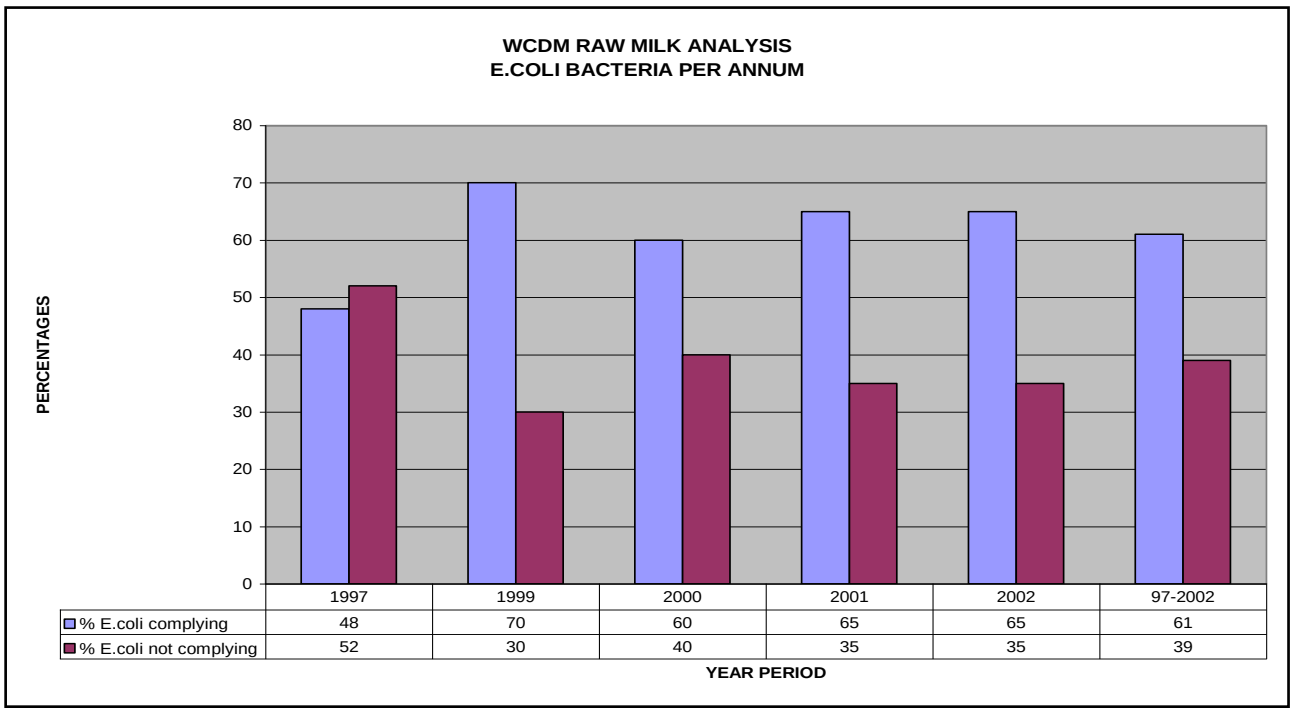


Figure 11: Raw Milk Analysis for *E.coli* Bacteria per Annum, WCDM Milk Statistics

- **The WCDM Raw Milk Analysis of *Staph. aureus* Bacteria**

In figure 12, raw scores for *Staph. aureus* bacteria that were not complying with legislative requirements scored 100% (1) for farm K in 2000.

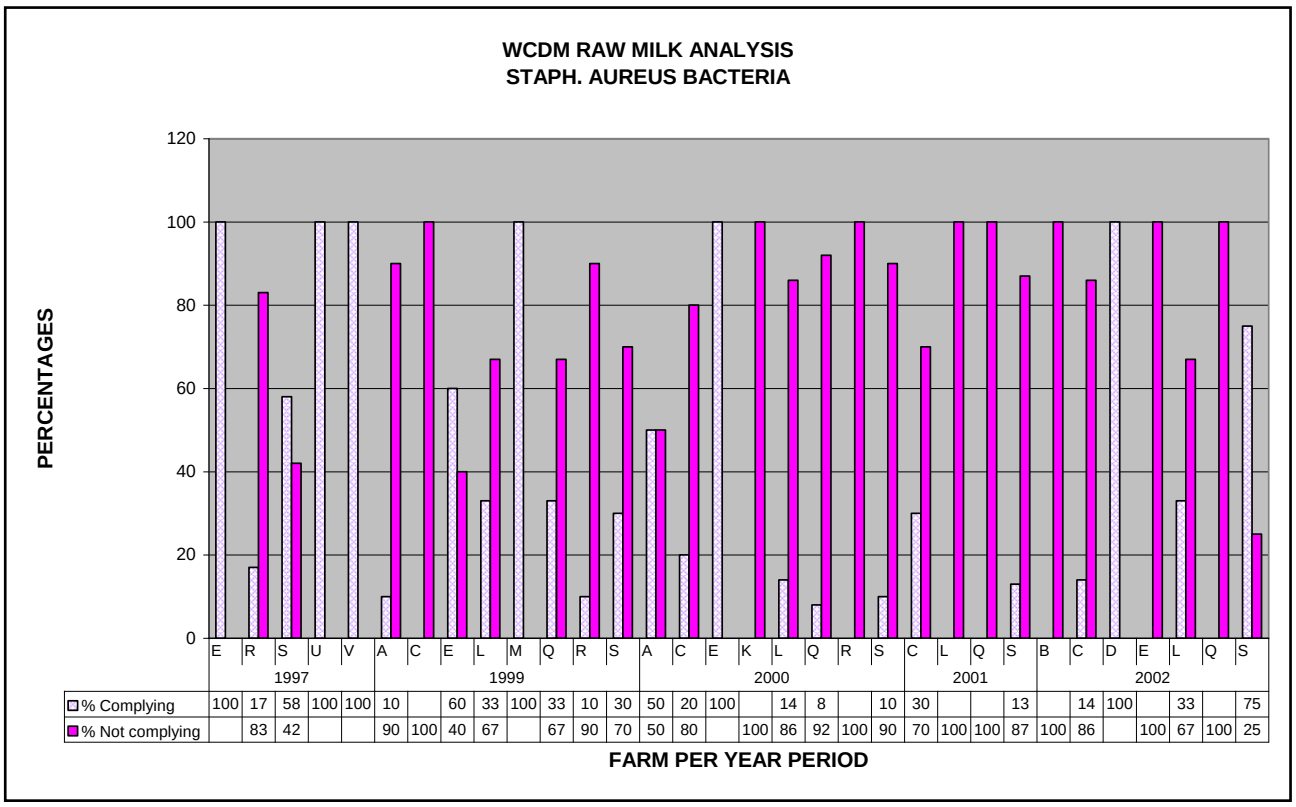


Figure 12: Raw Milk Analysis for *Staph. aureus* Bacteria per Farm, WCDM Milk Statistics

The incidence of *Staph. aureus* bacteria counts in raw milk scored 83% (10) in 1997 for farm R, with 90% (9) respectively for farm A and R in 1999; 90% (9) for farm S and 92% (11) for farm Q in 2000; 100% respectively for farms L (9) and Q (4) and 70% (7) for farm C in 2001; 100% (3) for farm B, and 86% (6) for farm C in 2002.

In figure 13, *Staph. aureus* bacteria counts in raw milk scored 54% (15) during year 1997; followed with 70% (37) in 1999; 81% (43) in 2000; 87% (27) in 2001 and 64% (16) in 2002. This indicated that the presence of *Staph. aureus* pathogens were relatively high in raw milk during the 1997 and 2002 period.

The total number of samples that did not comply with legislative requirements and rendering milk distributed in the SMA unsafe for human consumption scored 73% (138) for raw scores during the 1997 to 2002 period.

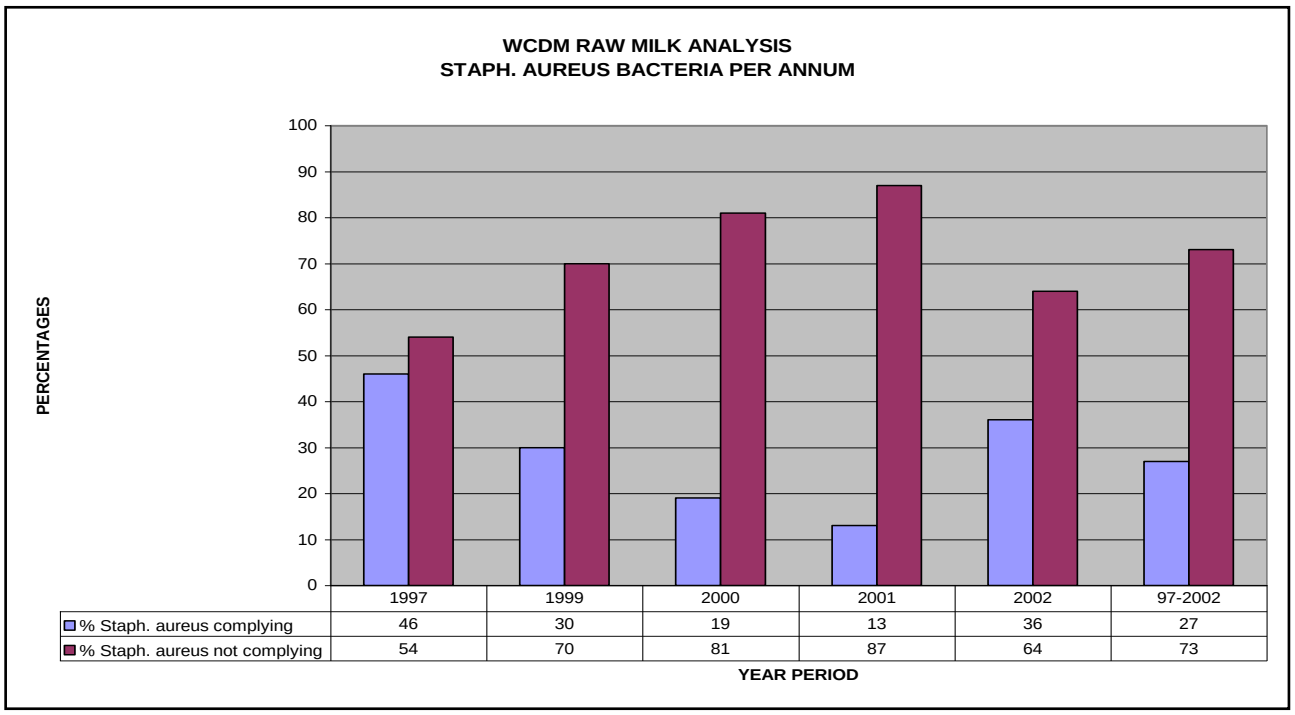


Figure 13: Raw Milk Analysis for *Staph. aureus* Bacteria per Annum, WCDM Milk Statistics

c) The Analysis of Pasteurised Milk for Indicator Bacteria

Figure 14 indicate the total number of samples that were analysed for indicator bacteria in pasteurised milk that were not complying with legislative requirements. In 1997, the incidence of raw scores for viable bacteria present in pasteurised milk scored 75% (3) for farm V and for farm E respectively with 50% (3) in 1999, 18% (2) in 2000, and 67% (2) in 2001; followed with 100% (1) in 2002 for farm V.

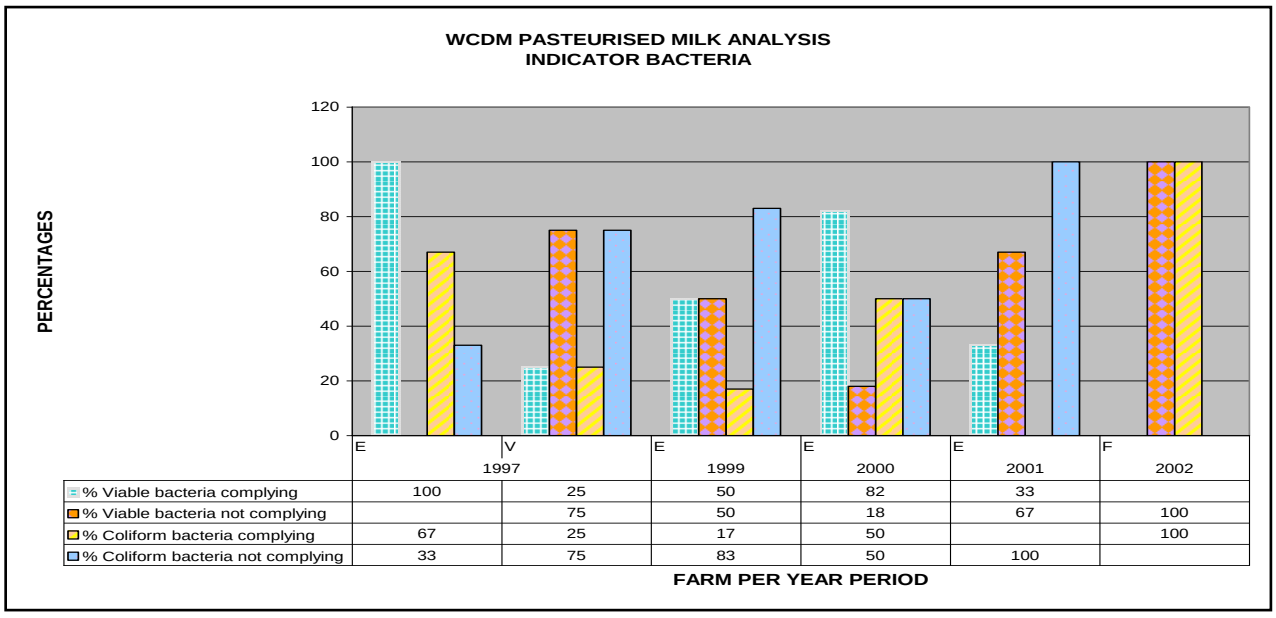
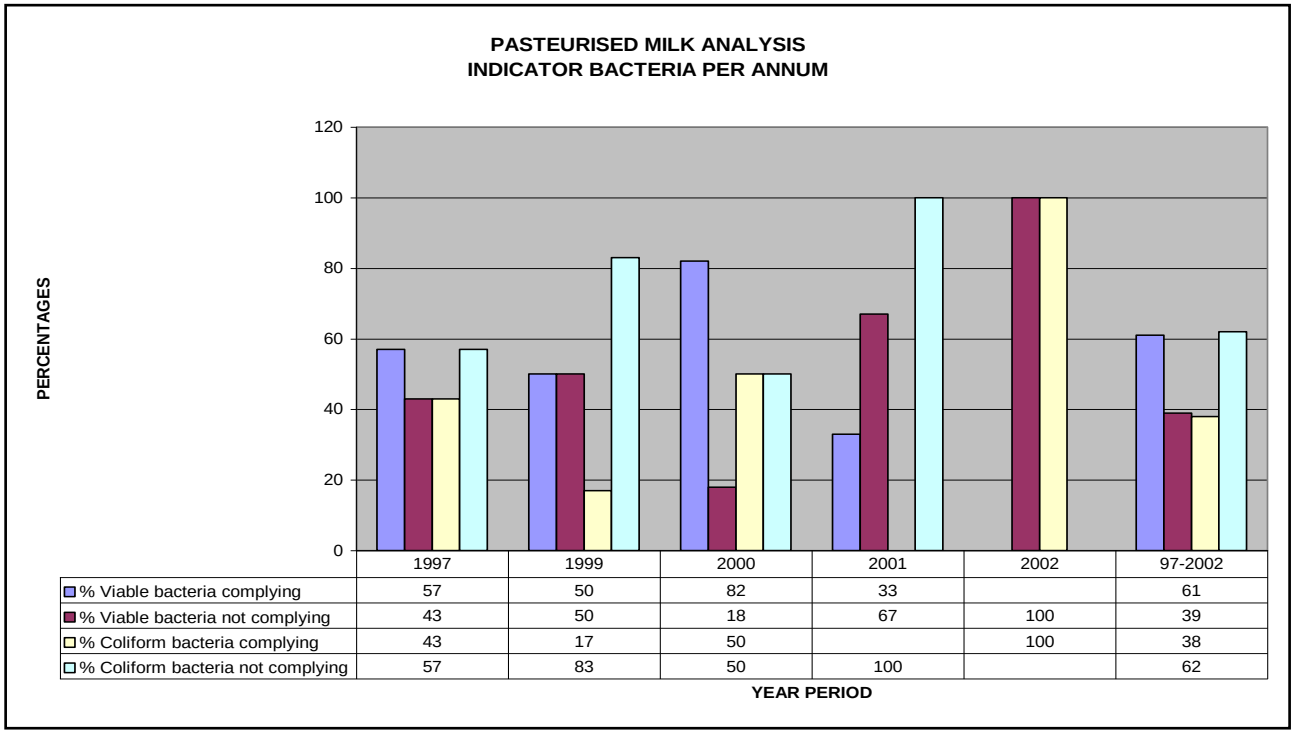


Figure 14: Raw Milk Analysis for *Staph. aureus* Bacteria per Farm, WCDM Milk Statistics

In 1997, the incidence of raw scores for coliform bacteria counts in pasteurised milk scored 75% (3) for farm V; farm E scored respectively 83% (5) in 1999, 50% (6) in 2000, followed with 100% (3) in 2001.



	1997	1999	2000	2001	2002	97-2002
% Viable bacteria complying	57	50	82	33		61
% Viable bacteria not complying	43	50	18	67	100	39
% Coliform bacteria complying	43	17	50		100	38
% Coliform bacteria not complying	57	83	50	100		62

Figure 15: Indicator Bacteria in Pasteurised Milk per Annum, WCDM Milk Statistics

In figure 15, the incidence of raw scores that was not complying for coliform bacteria counts in pasteurised milk scored 57% (7) for raw scores in 1997; 83% (6) in 1999, 50% (12) in 2000, followed with 100% (3) in 2001. The total number of samples that did not comply with legislative requirements for coliform bacteria scored 62% (18) for raw scores during the 1997 to 2002 period.

d) The Analysis of Pasteurised Milk for Pathogenic Bacteria

Figure 16 indicate the total number of pasteurised milk samples that were analysed for pathogenic bacteria.

The incidence of raw scores for *E. coli* bacteria counts in pasteurised milk scored 33% (2) in 1997 for farm E, and in 1999 and 2000 it was 45% (5) respectively for farm E.

In 1999, the incidence of raw scores *for Staph. aureus* bacteria scored 33% for farm E.

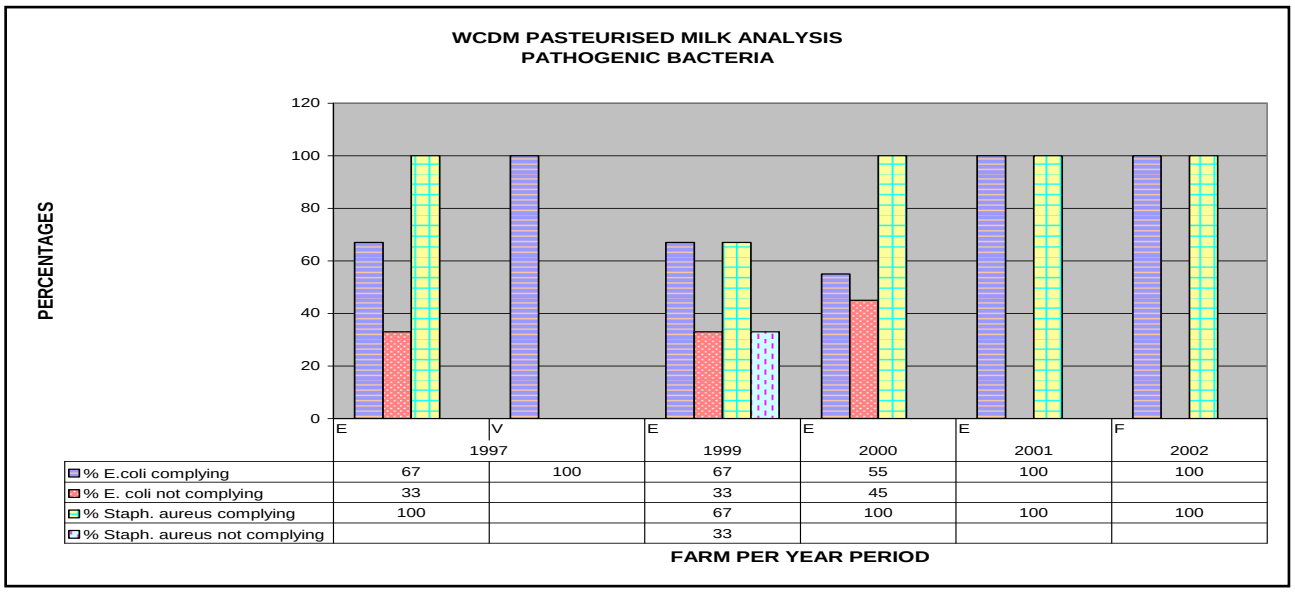


Figure 16: Pathogenic Bacteria in Pasteurised Milk per Farm, WCDM Milk Statistics

In figure 17, the incidence of *E. coli* bacteria counts that was not complying in pasteurised milk scored 14% (1) of raw scores during year 1997; followed in 1999, with 33% (2); and 45% (5) in 2000. The number of samples that did not comply with legislative requirements for *E. coli* bacteria was 29% during the year 1997 to 2002 period. In figure 17, raw scores that were not complying for *Staph. aureus* bacteria counts in pasteurised milk scored 33% (3) during year 1997. The number of samples that did not comply with legislative requirements for *Staph. aureus* bacteria were 8% during the year 1997 to 2002 period.

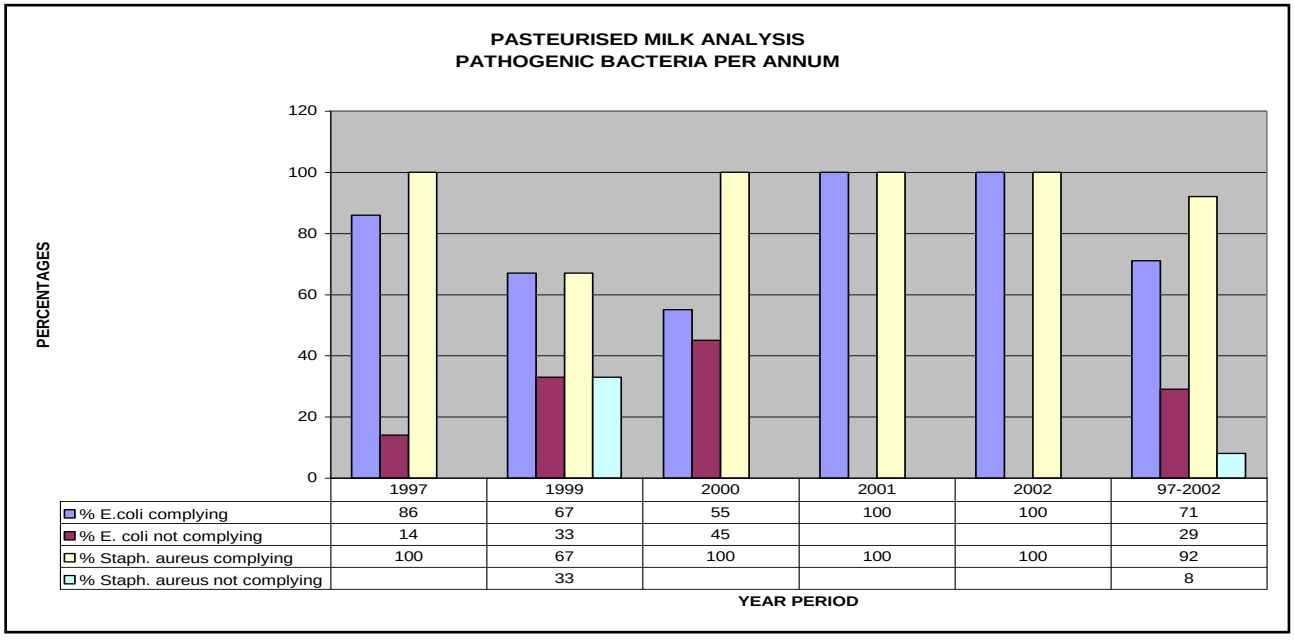


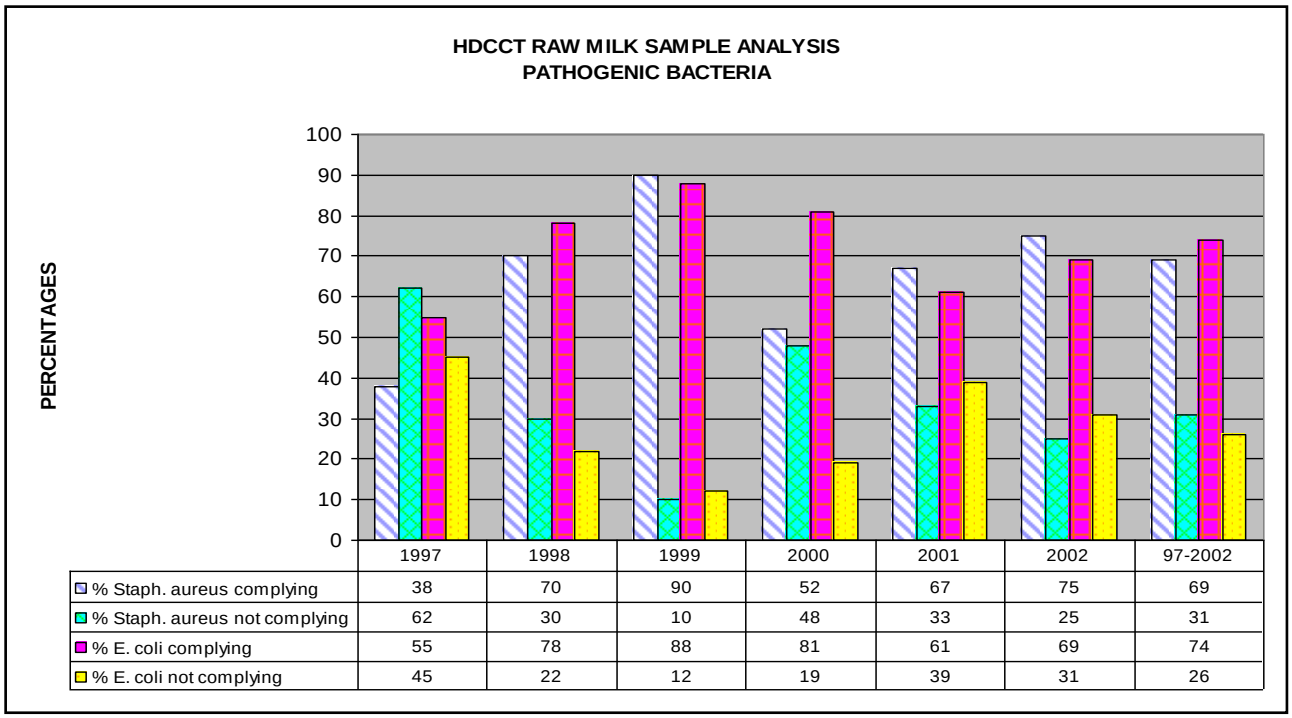
Figure 17: Pathogenic Bacteria in Pasteurised Milk per Annum, WCDM Milk Statistics

e) WCDM Milk Sample Analysis

The implementation of the monitoring programme for milking sheds was inconsistent. Milk samples ranged from one sample to a maximum of 15 samples taken per farm per annum. Among the farms monitored were cases of non-compliance for pathogenic bacteria. In some cases milk was not monitored concurrently for the two main pathogens namely, *E. coli* and *Staph. aureus* bacteria that were concentrated on.

Milk distributed to the public during the research period contained pathogenic bacteria and was thus unsafe for human consumption. The statistics showed that the compliance rate for pathogenic bacteria during the research period was much higher in raw milk comparing to pasteurised milk. The compliance rate for coliform bacteria was average for pasteurised milk.

5.4.2 The Case of the HDCCT



	1997	1998	1999	2000	2001	2002	97-2002
% Staph. aureus complying	38	70	90	52	67	75	69
% Staph. aureus not complying	62	30	10	48	33	25	31
% E. coli complying	55	78	88	81	61	69	74
% E. coli not complying	45	22	12	19	39	31	26

Figure 18: Pathogenic Bacteria in Raw Milk per Annum, HDCCT Milk Statistics

The sample statistics of the HDCCT illustrated the status of milk bacteriological quality in the SMA. A random sample of 68% was included in the analysis of the HDCCT milk sample statistics. The availability of information provided for the analysis of pathogenic

bacteria only. These statistical data relate to dairy farms extensively and demonstrate the milk quality standard in the SMA. Only raw milk was considered for this analysis.

Staph. aureus bacteria counts were 38% (48) for raw scores during 1997, 70% (119) in 1998, 90% (40) in 1999, 52% (207) in 2000, 67% (177) in 2001 and 75% (97) 2002. The incidence of *Staph. aureus* bacteria count for raw scores was 69% (688) during the 1997 to 2002 period.

E. coli bacteria counts were 45% (36) for raw scores during year 1997. In 1998 it was 22% (92), 12% (47) in 1999, 19% (97) in 2000, 39% (206) in 2001 and 31% (122) in 2002. The incidence for *E. coli* bacteria count for raw scores was 26% (600) during the period 1997 to 2002.

5.4.3 Analysis of the WCDM Strategic Policy Process

The WCDM policy strategy is analysed for its policy process performance and is based on the elements of the policy analysis process that is explained in Chapter 2. In this chapter, these policy elements are introduced by distinctive discussions on policy initiation, policy process design, policy analysis, policy formulation, policy decision, policy implementation, monitoring and evaluation. These discussions signify on policy actions that are linked to policy decisions that were taken by the WCDM.

5.4.3.1 Discussion pertaining to Policy Initiation

Distinctive policy actions indicated below, introduces the discussions pertaining to policy initiation and were undertaken as strategy to assist, control and address the problems the WCDM faces with milk control.

- **Milk Samplings**

This strategy is initiated through product quality monitoring. This is undertaken by EHPs of the WCDM taking milk samples on a monthly basis. Milk was sampled from the farm bulk tank prior to its distribution. Focusing on a limited number of milking sheds this strategy does not consider the overall milk quality status in the WCDM region.

- **Routine Inspections**

The hygiene of the milking sheds is assessed during inspections and makes correlations between on-farm hygiene and bacterial counts possible. Routine inspections also assure milking comply with statutory requirements. Notwithstanding this, Table 3 indicates that dairy inspections do not always proceed as a natural response in cases where non-conformance of sample analysis was observed.

- **A Visit to Dairy Farm**

The aim of this visitation was to orientate the EHPs with regard to possible problems that were encountered during milking, and also to make the farmer aware of possible problem areas identified by EHPs and the Department of Agriculture. Hence, the farmer was advised on corrective measures that could be undertaken during milking. These initiatives should support mechanisms and stimulate efforts to advance process control and strategy implementation. The outcome of neither initiatives nor mechanisms could not strengthen the WCDM strategy approach.

- **Workshops Concerning Milk**

Two workshops were launched by the WCDM. In 1995, the workshop on milk received wide representation from stakeholders in the field of milking. The topics that were discussed ranged from the role of the Department of Health in milk production and the distribution of milk, discussions on milk bacteriological sample analysis, the control of mastitis in milk animals, the production of safe milk and the overview and application of quality control over milk and milk products.

This workshop was attended by dairy farmers only who sold milk to the public. The meeting was merely informative and no decisions were taken on action concerning alternatives in view of the useful information given on how to address the bacteriological quality of milk. A second workshop was launched in 2002 in view of the status of milk bacteriological quality. This workshop was also widely represented with useful information shared by presenters. Dairy farmers invited have sold and distributed milk to the public. Yet again, no decisions on actions were taken.

- **Collaboration with the HDCCT**

A collaborative approach between the HDCCT and the WCDM was initiated to support the latter and assisting the WCDM with milk quality in the SMA. However useful the statistical information was for policy planning and for designing policy for intervention, the approach could not revise the current strategy. In addition, the HDCCT support mainly focused on sampling which is not sufficient to assure effective milk control.

Due to a lack of a joint programme of action and uniform objectives and goals, the collaborative agreement was not successful with regard to improving the milk quality produced at milking sheds.

5.4.3.2 Discussion pertaining to Policy Design

Milk sampling reports are the primary source of information underpinning the policy design phase. These reports inform the WCDM on bacteria present in milk and indicate on areas for intervention to improve the bacteriological status of milk. The processes of milk sampling and inspections with relation to milking sheds can assist with the design of innovative strategy. The non-compliance of bacterial counts is an appeal to transform the WCDM modus operandi on milk safety control.

- **Input from Interviews**

The following suggestions comprise input from EHPs during an interview dealing with bacteriological milk safety control.

- **Legislation**

Revision of certain bacteriological standard requirements is necessary. With regard to legislative requirements, the non-conformance is experience with respect to the certificate of acceptability prior to the operation of the dairy, proof to municipality of veterinary certificates for milk animals, proof of testing for water quality.

- **Producers**

The major portion of milk is mainly distributed to and collected from dairy farms by commercial dairy companies. The general view is that these companies should monitor the quality of milk. Monitoring of these commercial dairy companies during the research period was not successful.

- **Manpower**

Dairy farm inspections are complex and require much attention. The attainment of objectives is constrained by the shortage of personnel. Therefore, only those dairy farms that provide milk to the public were concentrated on.

- **Stakeholders**

There is a lack of communication between stakeholders and role-players in the milk domain.

- **Milking Sheds**

Milking processes need to be controlled more effectively; Inspections must be more frequent; Shortcomings identified must be discussed with farmers. Findings must be reported to council on a monthly basis.

5.4.3.3 Discussion pertaining to Policy Analysis

In this section the milk safety policy strategy is discussed in view of policy analysis. The following steps are followed when analysing the WCDM milk policy strategy.

- **Issue Filtration and Prioritisation**

The continuing non-compliance of bacteria levels found in milk and subsequent non-conformance with legislative requirements raises this policy issue to a priority worthy of investigation. The concurrent incidence of certain bacteria is linked to conditions that prevail during milk production.

The prevalence of certain bacteria and their quantities in milk that is observed over a period are necessitating urgent action. What needed to be considered for this thesis concerned the following: What actions were taken by the WCDM regarding the incidence of bacteria and the link to on-farm conditions? What presumptive relationships could be found between some groups of bacteria and the subjective quantitative analyses? How was information on bacterial control supplied by institutions of learning as well as the private sector used to assist with the clarification of priorities based on the problem situation?

- **Options Analysis**

The policy options considered for milk safety control relate to sampling and available resources. This involves what is to be sampled, the type of sampling to be undertaken, the frequency of sampling, sampling methods, sample equipment, sampling times and targeted farms for sampling. These considerations are options amongst alternatives to manage sampling processes. Procedures should be standardised and initiatives consistent as a means to achieve positive outcomes. The resources, which include financial resources, work force and equipment available for inspections and monitoring, should be effectively utilised during programme planning to obtain positive outcome results.

Supplementary to the above concerns, what needed to be considered by the WCDM, are other options apart from the conventional approach of inspections. The essence of intervention is linked to appropriate analytical tools that could be applied as options to improve the milking system.

- **Consequences and Predictions**

This *modus operandi* for inspecting milking sheds is quite autonomous and should be streamlined with regard to what needs to be targeted during inspections, frequency of monitoring, and action on processes. Shortfalls concerning auditing inspections and determining a programme for quality assurance have created a situation that favours inconsistency of inspections and makes it difficult to measure the success of any policy programme. An overseeing body could streamline the milk safety approach that is either lacking or fails to do what is required.

- **Set of Value Judgements**

The WCDM could enhance the policy analysis process by considering areas for improvement with regard to inspections and monitoring of milking sheds. Planning for policy should include the contributions of all stakeholders in the dairy arena that is involved with milking. Appropriate analytical tools are lacking and should be considered for devising inspection and monitoring programmes of milking sheds to obtain desirable policy outcomes.

5.4.3.4 Discussion pertaining to Policy Formulation

Problems pertaining to the formulation of policy are insufficient with regard to policy ownership by EHPs and the lack of stakeholders' participation. The workshop that was organised by the WCDM allowed for limited stakeholder participation. Only a few dairy farmers were included in the WCDM milk sampling programme.

The HDCCT as collaborative partner were not represented at the workshops. The manner in which the Environmental Health Unit enforces legislative standards also had to be clearly formulated. Formulated processes with regard to the enforcement of statutory requirements that would harmonise the critical problems associated with milking sheds are lacking.

5.4.3.5 Discussion pertaining to Policy Decision

EHPs have a legal obligation to assure that foodstuffs consumed by human beings are safe for consumption. The processes that were followed by the WCDM Environmental Health to assure this claim were based on; a) action taken for improving milk bacteriological quality; and b) action taken in terms of legislative requirements applicable to milking sheds.

The objective to inspect four dairy farms per month within a specified period formed part of the strategy approach to attend to milking sheds. However, this objective was not followed diligently. The bacteriological quality milk profile indicates areas for remedial action. A decision was taken by the WCDM concerning those farmers whose milk did not comply with milk quality standards, to be followed in terms of applicable law. However, the

recommended sanction was not introduced. A decline in milk quality represents shortcomings with the milk safety control approach and hence reflecting on the system that was implementing it.

- **Action taken with regard to Milk Sample Analysis**

The milk sampling results were measured for compliance in terms of Act 54/1972 as well as Act 63/1977. Correspondences formed part of the programme of action and were scrutinised for any strategic action that followed the non-compliance of laboratory reports of milk sampling analyses.

The focuses of correspondences, indicated in Table 3, were mainly on informing owner of possible legal action, and inform owner of bacteria present in milk. In Table 3, it is indicated that in most cases correspondences were issued without on farm inspections being undertaken.

Input of Notifications to Dairy Farmers As Response to Laboratory Reports	With inspection	Without inspection
• The testing for mastitis		XX
• Training of personnel		X
• Improvement of hygiene during milking		XX
• Attending to conditions		X
• Final warning		X
• Informing owner of possible legal action		XXXX
• Addressing problem areas.	X	
• Improving on milk quality.	X	
• Providing TB report of milk animals.	X	
• Inquiring into progress made with regard to problem areas		X
• Owner to give attention to the requirements of the regulation		XX
• Inform owner of bacteria present in milk		XXX

Table 3: Correspondences as Response to Milk Sample Laboratory Reports, WCDM Archive

- **Action taken with regard to Milking Sheds**

It should be noted that milking sheds cannot be operated as such without a certificate of acceptability that is required in terms of Regulation R 1259/1986. Only three of the 16 milking sheds from which milk samples were taken had obtained certificates of acceptability. Milk distributed to the public from milking sheds that had not have a certificate of acceptability during the research period hence contravened the requirements of Regulation R 1256/1986.

Correspondences that were issued to dairy farmers, indicated by an X in Table 4, serve as action taken on the side of the WCDM. These correspondences mainly focused on informing the responsible person to apply for a certificate of acceptability and to provide the municipality with a copy of the veterinary certificate proving that the milk animal was free from any contagious diseases like Tuberculosis (TB) and Brucellosis.

REMEDIAL ACTION	1997	1998	1999	2000	2001	2002
Problems to be remedied	xx	xxx	xx	x	xxx	
Owner to apply for Certificate of Acceptability	xxxx	xx	xxx	x	xxxxxx	x
Avail Council of TB and Brucellosis Certificate			xx	xxx	x	xxx
Requirements for Sanitary Facilities	xx	xx	x	x	xx	
Notification that Dairy Shed is not Approved	xx		xx		xx	x
Effluent Water System not Complying	x		x		x	
Owner to Stop Distribution of milk			x		x	xx
Possibility of Legal Action and Closure of Dairy Shed					x	
Fly Problem		xx	x			
Personal Hygiene			x			
Structural Problems			x			
Regulatory Compliance	xx	xx	x			

Table 4: Focus Areas of Correspondences Relating to Milking Sheds, WCDM Archive

In addition to the above, other focus areas were the requirements for sanitary facilities and the notifications that dairy sheds was not approved. These are specific requirements indicating also that the certificate of acceptability requirements was contravened. Problems to be remedied were also focussed on but what these problems constituted was not clearly specified. The problem areas that were focussed on in Table 4, were observed from milking sheds whom had a certificate of acceptability as well as those who had not have a certificate of acceptability. These problems indicated not just on the violation of lawful requirements but also that vigorous action lacked.

5.4.3.6 Discussions pertaining to Policy Dialogue

Referring to section 5.4.3.1, workshops were called to dialogue concerns about milk safety control. Though the concerns on the side of the WCDM were raised, input from dairy farmers was minimal. These dialogues were merely informative and could not procure precautionary action and identify stakeholder responsibility as possible outcome for the way forward.

5.4.3.7 Discussions pertaining to Policy Implementation

The implementation of the WCDM strategy is measured by its relevance, effectiveness and its performance in terms of its success factors. These success factors included indicators, control measures, inputs and outputs and potential risk analyses that were used for ensuring total quality management. This indicated how the policy strategy of the WCDM harmonised with the problem situation regarding milk safety that was experienced. In the case of this research, the magnitude of the risk is connected to the prevalence of bacteria that persisted over a period of years in raw and pasteurised milk. The outcome of the WCDM strategy should ensure that a safe and wholesome milk product is rendered in the WCDM region.

The effectiveness of the strategy was measured in terms of the implementation of policy decisions taken by the WCDM and subsequent actions forming part of intervention measures. The quality of milk could not be controlled effectively due to the lack of a clear-cut strategy and the inconsistent execution of the existing strategy. Other factors were the inconsistent monitoring of dairy farms, infrequent visits to dairy farms and the infrequent sampling of milk. The milk strategy was not condition-specific and thus not relevant to

addressing the environmental conditions causing bacteriological contamination. In this regard, adequate causal linkages between the WCDM milk safety strategies and the lawful requirements were lacking. Unclear policy objectives regarding how and what to target in relation to the quality of milk, the shortage of personnel, as well as the cost of monitoring, are possible obstacles that could impede effective policy implementation.

The indicators selected for this thesis were the incidences of non-compliance with regard to indicator and pathogenic bacteria over a number of years. Inappropriate process design could inevitably lead to inappropriate output results. The evaluation of any policy process should be included in the design phase. This policy lacked this. Risks relating to poor or unreliable supplier, weak links in the execution process, substandard equipment, inadequate financial resources, and the legal, technical, natural, political, social and cultural environments must be effectively managed.

5.4.3.8 Discussions pertaining to Monitoring and Evaluation

The technological monitoring approach used by the WCDM mainly relied on screening by which a collection of sampling points were managed. Programme-driven monitoring was lacking. The above-mentioned analysis indicated the inability of the WCDM to address the biological hazards and associated risks causing bacteriological contamination. This inevitably is the likely result of the application of policies that are non-responsive and ineffective.

5.5 Conclusion

The following conclusions are made by taking into account a) the safety of milk for human consumption, b) the constitutional right to an environment that is not harmful to health and well-being, and c) that the environment is protected for the benefit of present and future generations, through reasonable legislative and other measures. In terms of the safety of milk, the WCDM milk sample results for pasteurised milk compared to raw milk quality scored much higher in terms of its statutory compliance.

Secondly, the milk safety strategy failed to control those environmental conditions which nurture pathogenic bacteria that cause contamination of milk during production. Finally, in terms of the pathogenic bacteria found in milk success with statutory compliance was not

gained. This could either be due to the inadequate application or unclear and inconsistent execution of legislative requirements. The WCDM milk safety strategy could not assure the safety of food, in this case milk. The findings revealed why the WCDM was not successful in its approach to gain control over milk safety. The approach could not improve the raw milk quality significantly, rendering the strategy with regard to raw milk ineffective, though compliance of pathogenic bacteria for pasteurised milk was significant. This quite likely was due to heat treatment processes that were followed instead of control that was applied at dairy sheds during milking. The policy processes in chapter 2, as well as the criteria presented in chapter 3, for milk production, were used to evaluate the success of the WCDM policy performance. However, the milk control policy was not effective in evaluating and managing the biological risks associated with food. Management also was not committed to executing quality standards and quality assurance during milk production. The methodology followed by the Environmental Health Unit with regard to milk safety control could not succeed in ensuring that the milk quality standard maintains within legislative parameters. In that regard, the international analytical tools were not synchronised into policies.

CHAPTER 6

FINDINGS AND RECOMMENDATIONS

6.1 Introduction

The findings of this thesis and recommendations flowing from these are presented in this chapter. This will introduce policy guidelines that could result in an improvement of current policies or procedures. The relevance and effectiveness of policy implementation served as subjective indicators by which the bacteriological quality of milk was analysed. These indicators determined whether the policy had made a difference in resolving the problem situation that was experienced.

The magnitude of the policy problem was significant in terms of the duration of the problem, which continued over a period of years without success being gained on the side of management with improving the bacteriological quality of milk. The milk safety control strategy was not effective enough to evaluate and manage food risks and thus could not assure that the bacteriological quality of milk was at an acceptable risk level. Furthermore, intervention measures that were proposed by the WCDM failed to resolve the policy problem. In view of the above, an innovative approach is required that would improve existing policy. In that regard a Prevention-Based Systems Approach is proposed that is explained in the sections that follow.

6.2 Prevention-Based Systems Approach

Dale (1999:6,9) has stated that organisations who base their management approach on inspection and quality control are only operating in the decision type mode of finding and fixing mistakes. Changing from detection to prevention requires not just the use of a set of tools and techniques, but requires the various departments and functions to work and act together in cross-functional teams to discover the root causes of problems, and to pursue their elimination. In this regard, this research was challenged to collate the different viewpoints and perspectives on the control of milk safety into a workable, feasible and effective strategy of approaches to control the bacteriological quality of milk. Quality assurance is chosen for the inclusion of a prevention-based approach. In the prevention approach, there is recognition of the process as defined by its input of people, machines,

materials, methods, management and environment. This approach is proactive compared with an approach for detection, which is reactive, and which was used in the case of the WCDM. Dale (1999:4) identified the stages of quality control as well as Quality Assurance (QA) and Total Quality Management (TQM) as part of quality management.

The design of policy process should be based on internal and external environmental scans, analysis and adjustment. The ability, capacity, practices and culture of the organisation should be assessed to deal with risk strategies, risk tolerances and capacity to mitigate (Robillard, 2000). Bodman & Rice (1993) identified three features to be included in a safety strategy. These are cleanliness, sanitation and cooling. In the case of the WCDM, a suitable policy process that focused on biological risks was not followed.

According to WHO (2002) the traditional food safety measures have not been efficient, primarily because of problems linking hazard in foods to human health risk. The need for a proactive, systematic approach to prevent defects from occurring by monitoring the manufacturing process and raw material rather than testing end products for defects or the presence of contamination are emphasised by Purnendu, Vasavada & Cousin (as cited in Hui 1992:393).

In this regard, this chapter collates the policies of the WCDM to put them in line with international policies. The WHO proposes the HACCP as a prevention-based analytical tool for identifying microbiological risk. The challenge for environmental health is to devise inspections in line with the process requirements of the international analytical tools. Risk analysis is presented as one tool to address food safety problems and is aimed at identifying risk relative to the pathogen that can cause disease. A model is proposed that combines the analytical tools of HACCP and Risk Analysis and is based on an applicable policy process.

6.3 Conceptualising the Proposed Policy Framework

The proposed model presents a prevention-based approach towards developing the food control system. The milk safety policy is unique due to the combination of processes considered for the different conditions that may influence milk quality. Moreover, in Annexure 6, a milk policy framework is proposed for strategic intervention. In this framework, quality is created in the design stage and not in the later control stage through

the mere testing for bacteriological quality. The simple inspection activities are thus replaced or supplemented by quality control (Dale, 1999:4). The following recommendations are made for the sampling of milk. A standardised process should be followed by all concerned with monitoring and testing milk quality. The procedure should be clearly outlined and documented so as to ensure consistency and equality with the administering of the sample. Appropriate sampling equipments should be used when taking samples. On-farm inspection is vital in cases where samplings do not comply with legislative standards. Inspection procedure should also be documented and should clearly outline when and how inspections need to be undertaken.

6.4 The Milk Policy Framework

The milk policy framework is underpinned by the principles of:

- Risk analysis;
- Hazard Analysis Critical Control Point Principle;
- Quality assurance; and
- Generic policy process.

This policy framework is explicitly described through three distinctive management phases. The significance and relevance of each phase is discussed as it relates to applicable policy principles. The risk-hazard analysis profile phase is the planning mode of the management process. Risk analysis is used to give structure to policy decisions and includes risk assessment, risk management and risk communication. The policy framework is constructed on the principles of quality assurance which ensure that a feasible programme of action is performed.

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6.4.1 The Risk-Hazard Profile Phase

Firstly, the risk-hazard analysis profile phase emphasises stakeholder involvement as part of the developmental process. Stakeholder involvement should be widely represented and should not be limited to the affected publics. Input from these stakeholders is also important to buy into the problem situation. Here the risk connected to a specific hazard is evaluated. The risk-hazard condition is designed within a policy process and decisions on what to do with the policy problem is quantitatively defined. Policy can only be formulated

once the problems that are experienced within the milking arena have been identified. The analysis of risks should form part of the initiatives of the policy process that precedes the design of policy.

Secondly, the risk-hazard analysis profile phase clarifies the legislative framework. This not only gives direction for steering policies, but should ensure that lawful requirements are embraced and implemented. This will determine the threshold of the hazard and the extent it can cause disease. When problem conditions prevail over period of time the likely impacts as well as the magnitude of the risks should be identified and the legislative framework should be established. Legislation or policies derived there from could serve as measuring tool. The mitigation measures in dealing with the risk/hazard should also be identified.

6.4.2 The Quality Assurance Phase

This phase addresses the quality of foodstuffs relative to its bacteriological quality requirements. The quality of foodstuffs may implicate on possible food-borne risks and biological hazards that can be derived there from. This process must assure that quality standards of milk are contained within the legislative framework. Environmental scanning is necessary for assessing the general and specific environment. This phase also measures the quality of activities during milk production processes. These relate to inter alia the strength of sanitation, cooling, and cleaning activities. The formulation of policy however is related to its policy dimensions as well as the success factors of the strategy activities.

6.4.3 The Policy Strategy Phase

This phase identifies strategic decisions on actions to be followed regarding the choices made amongst the alternatives. Hence a framework that is indicated in Annexure 5, for the intervention of policy strategies is proposed. During this phase, the intermediate and outcome goals, the programme of action to be followed, the projects and the plans are identified.

Causal linkages between the outcome goals and the programme activities should be established and continually assessed. The risks linked to strategy should be managed and

communicated throughout the policy process. The approach of this phase is emphasising programme planning for solving policy problems. The policy programme for each strategy consists of process steps that are linked to programme elements. These elements are the targets and indicators, tasks, activities, resources, the budget, and time frame. In this regard, choices are made on policy and programmes that relate to sanitation, hygiene and cooling. In the section that follow, this phase introduce strategic options on sanitation, hygiene and cooling.

6.5 Strategic Programmes Intervention

Pathogenic bacteria that are detected in milk are an indication of bacterial contamination, which vitally require intervention. The suggested strategies for intervention with regard to sanitation, cleanliness (hygiene) and cooling are based on the policy framework proposed for implementation. This framework is based on the adoption of an integrated approach. Such an approach strengthens synergies between the components of the development dynamic, and directly addresses the development imperatives.

The success derived from implementing this policy framework is based on coordinated actions, causal linkages and the management of risks. An approach is required to transform environmental health strategic thinking. In this regard, current policy strategies should be reinvented. Similarly, management style should be transformed to ensure that the quality of policies, targets and objectives are aligned with the organisations goals. In this regard EHPs should be trained in the application of the analytical tools that are valuable and essential for the developmental nature of the career path. A policy deployment process is required for the implementation of policies. The ideal situation in policy deployment is that the plan, targets and improvements should be communicated to staff. This ensures the penetration and communication of policies, objectives and continuous improvement throughout the organisation, with the general objectives being converted into specific objectives and improvement targets.

There must also be some form of audit at each level. This is to check whether targets that are set and improvements that are made, are communicated to clients (Dale, 1999:45). The programmes regarding sanitation, cooling and hygiene (cleaning) are proposed to suggest a milk safety policy model. Programmes should be devised to ensure that the following priorities receive attention:

- Promoting programmes and sub-programmes on sanitation, hygiene and cooling
- Developing an efficient milk control system
- Strengthening the milk control system
- Ensuring collaboration with stakeholders in the field of milk safety
- Ensuring that foodstuffs, milk in this instance, is safe for human consumption and distribution
- Formulating a milk safety policy and plan of action
- Developing and updating intervention strategies

6.5.1 Programme: Sanitation

The sanitation programme is structured by main policy objectives, strategies and indicators.

6.5.1.1 Main Policy Objectives

These main policy objectives include the following:

- Create a partnership with the private sector to ensure that resources are optimally used.
- Develop regional strategies on sanitation for improved milk quality.
- Develop acceptable sanitation practices for the elimination of bacterial contamination during milking.
- Establish sanitation programmes for the various elements involving sanitation.
- Develop a quality assurance system to monitor progress.

6.5.1.2 Strategies

The following sanitation strategies are proposed.

- Collaborate with private sector to identify and develop tools to improve sanitation practices.
- Develop strategic protocols or guidelines and procedures for best practices to improve sanitation during milking.
- Establish hygiene procedures to ensure hygiene during milking.

- Evaluate and audit pest control programmes for milking sheds.
- Develop water quality and safety monitoring programmes for milking sheds.
- Evaluate and audit the effluent waste water system for acceptability and pollution control.
- Evaluate and audit the handling and storage of manure.
- Institutionalise and recognise quality assurance mechanisms in relation to implementation.

6.5.1.3 Indicators

Indicators that relate to sanitation should include suitable programmes and practices, applicable monitoring systems as well as appropriate quality standards.

- Existence of a programme to strengthen advocacy for public/ private partnership.
- Availability of legislation and regulatory procedures for milking practices.
- Milking practices compliant with legislation.
- A system to monitor procedures ensuring hygiene during milking.
- A system to monitor pest control programmes.
- A system to monitor water quality and safety programmes.
- A system to monitor the effluent water system for acceptability and pollution.
- A system to monitor the handling and storage of manure.
- Establishment of quality assurance standards and indicators.
- A system to audit the elements of sanitation
- The existence of guidelines and procedures for milking practices

6.5.2 Programme: Hygiene (Cleaning)

Develop hygienic standards for milking sheds in line with WHO guidelines

6.5.2.1 Main Policy Objectives

The policy objectives for hygiene (cleaning) include:

- Developing and implementing a hygiene protocol for cows, the cow environment and personnel

- Develop hygienic standards for milking sheds in line with WHO guidelines
- Appropriate cleaning practices and procedures for personnel and the cow environment
- Establishing a cleaning routine

6.5.2.2 Strategies

The strategies with regard to Hygiene include:

- The existence of hygiene standards for milking sheds
- Cleaning programmes and practices established
- System monitoring cleaning practices
- System monitoring in line with sampling programme

6.5.2.3 Indicators

Indicators on hygiene should measure the success of system monitoring practices and programmes. This is done by:

- The input of cleaning programmes
- The outcome of cleaning programmes
- The degree of bacterial compliance upon testing

6.5.3 Programme: Cooling

The cooling of milk, presented in the strategies, should be controlled effectively.

6.5.3.1 Main Policy Objectives

Develop a mechanism to control the cooling of milk

6.5.3.2 Strategies

Strategies should ensure that the required temperature is maintained which include:

- Check cooling of milk prior to distribution
- Monitor temperature settings in line with legislation
- Record temperature settings

6.5.3.3 Indicators

The outcome of indicators should measure the success of strategies by:

- Auditing reports on cooling
- Bacteria linked to inefficient cooling

6.6 Conclusion

In the previous chapters the efforts to control the bacteriological quality of milk by the WCDM was presented and was not successful due to several factors. These are the ineffective strategy that was followed; lack of will to take stringent action; inconsistent compliance monitoring; insignificant impact of strategy; management that operated in the decision mode; and the detection of biological hazards was not always followed by on-farm inspections.

This chapter has presented the findings of this research, which have indicated that a new approach is required to cater for unique problem situations. Policy decision-making should respond to actual problems that are experienced. New strategies are required for the changing challenges that confront the environmental health unit of the WCDM. This indeed shows that policy strategies should be reinvented and that a new management style is required to address the suggested policy approach that is to cater for the real situations. It is a challenge yet to be mastered by the WCDM to ensure that milk produced at milking sheds is safe and suitable for human consumption.

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ANNEXURE 1: SIGNIFICANT PATHOGENIC MICRO ORGANISMS IN FARM MILK PRODUCTION

Pathogenic Organism	Key Farm Sources
Staphylococcus aureus	Infected individuals (nose, throat, skin, cuts); infected cow udders
Streptococcus pyrogens	Infected individuals (throat lesions)
***Salmonella* species**	Soil, manure, human faeces, unsanitary equipment, rodents, cockroaches, flies
Clostridium perfringens	Soil, manure, human faeces, unsanitary equipment, rodents, cockroaches, flies
Campylobacter jejuni	Manure, human faeces, unsanitary equipment and contaminated water
***Escherichia coli* (0157:H7)**	Soil, water, manure, equipment and human faeces
***Shigella* species**	Human faeces, unsanitary equipment and contaminated water
Yersinia enterocolitica	Contaminated water, unsanitary equipment, rodents, swine
Listeria monocytogenes	Soil, fresh-water, mud, manure, faeces, improperly fermented silage, floor drains, unsanitary equipment

Source: Tybor & Gilson, 1993: Cooperative Extensive Service, Athens

ANNEXURE 2: MICROBIOLOGICAL TESTS

Standard Plate Count (SPC) **Quality Milk = < 50,000 cfu/1.0ml milk**	**Modified Eijkmann Test (MET) for *Escherichia Coli* (*E. coli* = < 0/1,0ml**
This test counts the total viable bacteria in a Millilitre (ml) of milk. The SPC is an indicator of sanitation in milking cows, milking system Cleanup and certain types of mastitis. Major factors affecting SPC are the level of herd mastitis and high numbers of late lactation cows. Other factors are milkers' employee hygiene, cow and milking system cleanliness, milking equipment, condition of rubber parts, and faulty milk pump seals.	This test counts the *E. coli* bacteria in O ml of milk. The MET is an indicator of pathogens producing toxins known as verotoxins. Factors affecting the MET are dairy cattle. The presence of *E. coli* are mainly due to faecal contamination of water and other foods, as well as cross contamination during food preparation can lead to infection, as can person to person contact.
Coliform Counts (CC) **Quality Milk = <20cc /1,0ml milk**	**Somatic Cell Counts (CC)** **Quality Milk = <500 000/1,0ml milk**
This test counts faecal bacteria in milk and coli organisms shed by cows into milk. The main factors affecting CC are milking wet and dirty cows. Coli mastitis cows rarely contribute to CC but can elevate the count. Occasional problems are from defective milking system cleaning and dirty condition of equipment parts not touched by hot wash water.	This test generally indicates sub clinical or invisible Mastitis problems in the herd or individual cows. High SCC is a sign of mastitis. One cow with mastitis can notably increase milk tank SCC. Suspected cows are to be removed from the main herd and treated. Chronic cows should be culled and milk separately. Possible sources of mastitis are infected cows and late lactation cows, bedding and corral conditions milking procedures and equipment.

ANNEXURE 3: SOURCES OF MICRO ORGANISMS

Sources of Micro-organisms		**Author**
The Environment	Milk handling equipment Air-borne contamination Farm water Bedding Feed and dropping of milking machine teat cluster	Varnam & Sutherland (1998:35, 36)
	Poorly designed equipment and constructed pipeline systems Inadequate cleaning and sanitation between milking Build-up at dead-ends Failure to carry out cleaning instructions Teat cup if not disinfected after each milking Manure	Ruegg (University of Wisconsin, 2001, p.1)
The Milk Animal	Soil from the belly Flanks, tail and udder Joints and fittings	Tybor & Gilson (October 1993)
	Mastitis infected animal or other infectious diseases Quarters of udder infected with mastitis	
Personnel	Contact with soil and manure on the cow Infections Improper Cleaning Touching of milking machine with unclean hands Unsanitary practices of employees	

ANNEXURE 4: MILK QUALITY STANDARD

	Raw Milk for Further Processing	Raw Milk for Human Consumption	Pasteurised Milk	Sterilised Cream, or UHT Cream or Milk	Milk Products or Composite Dairy Products
Standard Plate Count (SPC) per 1.0 ml	< 200 000 Per 1,0 ml	< 50 000	< 50 000 Per 1,0 ml	-	* < 50 000
Somatic Cell Count (SCC) per 1.0 ml bovine milk after 3 successive readings, intervals of 7 days during test period	An Average of 500 000 cells per 1,0 ml				
MPN of Coliforms in 1.0 ml	Not more than 10,0 per 1,0 ml	Not more than 10,0 per 1,0 ml	Not more than 10,0 per 1,0 ml	-	Except ripened cheese. Not more than 50
Colony Forming Units (CFU) per 1.0 ml	Not more than 20,0 per 1,0 ml				
Escherichia Coli per 0,01 ml (modified Eijkmann test)	None in 0,01 ml	None in 0,01 ml	None in 0,01 ml	-	None in 0,01 ml
Escherichia Coli per 1,0 ml (VRB MUG agar method, or dry dehydrated film method)	None in 0,01 ml				
Pathogenic organisms	No Salmonella, Shigella or *Staphylococcus Aureus*				
Brucella Ring Test	Negative	Negative	-	-	-
Phosphates	-	-	Negative	-	-
Antibiotics or other antimicrobial substances	Absent	Absent	Absent	Absent	Absent
Clot-on-boiling test	Negative				
Ethanol test	Pass				
Packed in closed container	Yes				

Source: Summary from Milk and Dairy Products Regulation, R. 1555-21 November 1997

ANNEXURE 5: MILK SAFETY STRATEGY FRAMEWORK