OPPORTUNITIES FOR ECO-EFFICIENCY AT SUMMERPRIDE FOODS LTD – A PINEAPPLE PROCESSING FACTORY

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ABSTRACT

International awareness and demands for the protection of the environment by the public on industry has only been pushed into the limelight in the past couple of decades. Prior to this it could be argued that it was accepted that environmental protection and economic development were at odds. However it has since been recognised that there is a need to achieve environmental sustainability, the concept of which was released in the 1987 Brundtland Report released by the United Nations. There are a number of ways that industry can reduce its impact on the environment and thus help reach this goal.

While some advocated that stricter legislation would result in greater innovation by industry in “cleaning-up” its act, such as the Porter Hypothesis, there were also a number of new concepts and voluntary industry codes being developed. These new practices and codes have been promoted by organisations such as the International Chamber of Commerce and include technological improvements within organisations and improved resource productivity.

The aim of this case study research was to find out what the environmental policy and related performance of Summerpride Foods Ltd, a pineapple processing factory in East London was and does an understanding of its environmental performance provide insights for improved efficiency. This involved the identification and analysis of what resources were used during the processing of pineapples as well as making recommendations that would result in increased efficiencies of their use. Due to the number of resources identified, only the use of water and coal which were ranked as having the highest impact were investigated further.

The literature review showed that there are industry moves to applying cleaner production and eco-efficiency concepts as a means to attaining environmental sustainability. There are a number of voluntary environmental management system standards and codes that organisations can subscribe to with most probably the ISO 14001 standard being the most internationally recognised. There are many benefits to organisations adopting such standards. The use of life-cycle assessments is a useful tool that can be used to assess the environmental impact of a product through its entire life and thus enable one to identify all resources used and their impact, as well as to provide the information required to quantify areas where the greatest improvements can be made.

The results of this research showed that at the start of the study, there was no formal environmental policy in place at Summerpride Foods Ltd and that this was starting to become a requirement with some customers. The detailed results which focused on water and coal usage showed that current operating methods do not recognise the importance of any wastage and that there are a number of changes that could be made that would not only result in better efficiency of use but would also result in substantial financial savings to the organisation. Summerpride Foods Ltd currently has a number of systems in place that help reduce its impact on the environment but these are not formally recorded.

Summerpride Foods Ltd should adopt the principles of eco-efficiency and record all systems that impact on the environment. This would be the first step to attaining a formal environmental management system accreditation which due the increasing competitiveness of the international market in which Summerpride Foods Ltd operates, would give it a degree of advantage over those competing pineapples processing factories that do not have such accreditation.

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ACRONYMS

BRC	British Retail Consortium
CIAA	Confederation of the Food and Drink Industries of the EU
EFSIS	European Food Safety Inspection Standard
EMAS	Eco-management and Audit Scheme
EMPS	Environmental Management Plans
EMS	Environmental Management System
EU	European Union
EUREPGAP	European Good Agricultural Practice
FBI	Food and Beverage Industry
HACCCP	Hazard Analysis Critical Control Points
ICC	International Chamber of Commerce
IISD	International Institute for Sustainable Development
IOD	Institute of Directors
ISO	International Standards Organisation
LCA	Life Cycle Assessment
SPF Ltd	Summerpride Foods Ltd
UK	United Kingdom
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Program
US EPA	United States Environmental Protection Agency
WBCSD	World Business Council for Sustainable Development
WCED	United Nations' World Commission on Environment and Development
WCS	World Conservation Strategy
WRI	World Resources Institute

CHAPTER 1: OPPORTUNITIES FOR ECO-EFFICIENCY AT SUMMERPRIDE FOODS LTD – A PINEAPPLE PROCESSING FACTORY

1.1 Introduction to Sustainable Development

For many decades, it could be argued that environmental protection and economic development appeared at odds. Experts believed that the two were mutually exclusive and to gain in one meant a loss in the other (Daly, 1987).There is increasing concern today over the ecological sustainability of human development on this planet, with population growth and resource consumption depleting natural resources faster than their renewable productive potential. The increase in waste products and pollution further damage natural systems and upset essential life support processes such as the carbon cycle and the maintenance of stratospheric ozone (Dahl, 1995).

The first concept of environmental sustainability was recognised soon after World War 11, when it became accepted that the utopian view of technology-driven growth was not the ideal and that the quality of the environment was linked closely to economic development and public awareness was raised by publications on the subject, such as Rachel Carson's Silent Spring (Carson 1962), in which, based on extensive scientific studies, she argued that humans and nature are interdependent. She also argued the point that human industrial activity can and does cause permanent damage to the Earth's ecosystems. Whilst her focus at that time was on the chemical DDT, she showed how toxins, once in the food chain can have severe, unpredicted and far reaching ecological consequences. Hardin (1968) in his article "The Tragedy of the Commons" stated: *"The tragedy of the commons as a food basket is averted by private property, or something like it. But the air and waters surrounding us cannot readily be fenced and so the tragedy of the commons as a cesspool must be prevented by different means, by coercive laws or taxing devices that make it cheaper for the polluter to treat his pollutants than to discharge them untreated."* At that time, it could be said that most governments and businesses accepted degradation of the environment as an unfortunate side effect of economic growth and development but that increased public awareness of environmental issues galvanised both individual countries and communities into action.

The environmental problems were dealt with in a re-active, rather than pro-active manner (UNEP, 1999). The United Nations (UN) took a while to react to the threat of global degradation and it was only in 1987 that it released what is commonly referred to as The Brundtland Report, where the term "sustainable development" was first coined and promoted. This was done by the United Nations' World Commission on Environment and Development (WCED). The core of its definition combined global economic and progress with respect for natural systems and environmental quality (Andrews *et al.*, 1999). The International Chamber of Commerce (ICC) acknowledges that economic vitality, employment creation and environmental protection are strongly interrelated, and business continues to be an integral contributor to all three. It also recognises the fact that all companies, regardless of size, sector or location, can make significant contributions to sustainable development by improving their internal management of environment, health and safety (ICC, 1998). The ICC Charter calls upon firms to recognise environmental management *"as among the highest corporate priorities and as a key determinant to sustainable development"* (ICC, 1993: 46 A.1).

According to Porter and van der Linde (1995), in their article 'Green and Competitive: Ending the Stalemate', it was argued that the conflict between environmental protection and economic competitiveness is a false dichotomy based on a narrow view of the sources of prosperity and a static view of competition. They also stress the need for regulation to protect the environment and say that properly designed environmental standards can trigger innovations that lower the total cost of a product or improve its value. Their research showed that competitiveness highlights the role that outside pressure, from competitors, customers and regulators plays, in motivating companies to innovate. They go on to say that data clearly shows that the costs of addressing environmental regulations can be minimised, if not eliminated through innovation that delivers other competitive benefits. They equate pollution with inefficiency as it is a sign that resources have been used incompletely, inefficiently or ineffectively and promote the concept of resource productivity which can be analysed in the life cycle of a product. They went on to say that although pollution prevention is an important step in the right direction, ultimately companies must learn to frame environmental improvements in terms of resource productivity. They argue that at the level of resource productivity, environmental improvement and competitiveness come together.

With regard to innovation and environmental regulations, they say there are two broad categories. The first is new technologies and approaches that minimise the cost of dealing with pollution once it occurs. The second and more important type of innovation addresses the root causes of pollution by improving resource productivity in the first place. Using the second category, they suggest that companies that can see the opportunity first and embrace innovation-based solutions will reap major competitive benefits. They gave the example of how Japanese and German car makers innovated in the light of new fuel consumption standards compared to their US counterparts who attempted to legally challenge these standards (Porter and van der Linde, 1995).

In order for a company to progress towards a more competitive environmental approach, they suggest a company first measure its direct and indirect environmental impacts which are often unknown. Their research indicated that this act of measurement alone leads to enormous opportunities to improve productivity and that companies that adopted the resource-productivity framework and go beyond currently regulated areas reap the greatest benefits. This is critical in today's global market place where the notion of comparative advantage is becoming obsolete. Competitiveness is now being realised by using resources more productively and not by access to the lowest-cost inputs. In this regard, Porter and van der Linde (1995) imply that the way industry responds to environmental problems may be a leading indicator of their overall competitiveness. They also argue that in the light of environmental regulations, only those companies that innovate successfully will win.

Pineapples are grown around the world today and are the third most important tropical fruit in world production after banana and citrus in terms of tonnage. Whilst seventy percent of the pineapple produced in the world is consumed as fresh fruit in the country of origin, there is a sizeable international market in processed fruit, which is dominated by a few multinational companies that have developed the infrastructure to process and market pineapple (Bartholomew *et al., 2003).*

Thailand and the Philippines dominate processed pineapple world trade today as their large-scale production, coupled with a high level of technology and low labour costs makes competition with production, processing and marketing very difficult for the smaller producing countries such as Australia, South Africa, Kenya etc. It is only the efficiency of production and processing that allows smaller producers to stay in the market (Sanewski and Scott, 2000). Even production in Hawaii, where commercial processing started, production has declined steadily as production and competition in processed products from the Far East has risen. Hawaii now concentrates on a domestic and export fresh-fruit market (Bartholomew *et al.*, 2003). Other countries, such as Australia and South Africa, are facing a similar situation. The Australian industry is facing a very difficult time currently with the company, Golden Circle, which processes all pineapples there, suffering major losses in profit in the past couple of years (Scott, 2005). In the case of South Africa, a number of canneries have gone out of business in the past couple of decades. These include False Bay Canners and Zululand Food Processors in KwaZulu-Natal, as well as Deepfreeze and Preserving, and Sunny South Canners in the Eastern Cape. Likewise the pineapple industry in the Eastern Cape of South Africa, where all processing in the country takes place in either of two canneries, is facing extremely challenging time due to increasing costs (Figure 2.3**)** and a firmer rand as it battles to compete on the international market (Duncan, 2005).

1.2 Research Objectives

Summerpride Foods Ltd situated in East London, is the largest of the two canneries in operation, processing around 100 000 tons of pineapple per annum. In reaction to these challenges, SPF Ltd has concentrated on cost savings with regard to labour and fruit, followed by maintenance and has largely ignored utilities such as water, energy sources and other items that have an effect on the environment (Bobbins, 2006).

The overall goal of this research is to is to develop a plan which when implemented will improve the sustainability of Summerpride Foods Ltd (SPF Ltd.), a pineapple processing factory in East London, with the specific aim of achieving this through the improvement of environmental performance. Thus the objectives of this research were to:

a) Establish the environmental sustainability of SPF Ltd and to identify opportunities for further improvement;
b) Determine the capacity of SPF ltd to adopt the identified opportunities; and
c) Recommend management plans for the integration of such improvements into SPF Ltd corporate development strategy.

The key questions to be addressed in obtaining these objectives are:

i. What is the current environmental policy and related performance of SPF Ltd?
ii. Does the understanding of environmental performance provide insights for improved efficiency?
iii. How should the above influence the development strategy of the business?
iv. What indicators would be applicable for the ongoing monitoring of environmental performance within the industry?

1.3 Dissertation Structure

The remainder of the dissertation consists of Chapters 2 to 6. The contents of each of these chapters is summarised below.

CHAPTER 2 provides a review of relevant literature pertaining to the concept of sustainable development, starting with the definition of sustainable development, then reporting on some of its history. Both international and South African trends in this regard are discussed, along with businesses response to the implementation of sustainable development principles. The use of indicators as a tool to measure sustainable development and the need for sustainable development reporting, along with its history and international and local trends is explained. Sustainable development in agri-food business is introduced and, more specifically, the pineapple industry, including some of the challenges it faces competing on the international market.

CHAPTER 3 reports on the research methodology used and the justification of using this method for this research**.**

CHAPTER 4 deals with the inventory analysis undertaken and also gives a detailed analysis of resources used with SPF Ltd.

CHAPTER 5 discusses the results the results of the two resources highlighted in Chapter 4 in a detailed analysis and makes recommendations with regard to possible improvements in their usage.

CHAPTER 6 is a general discussion about what strategy SPF Ltd should take in the future with regards to the environment as well as the other two legs of sustainability. It also gives details about some of the measures that are in place in this regard.

CHAPTER 2: LITERATURE REVIEW

2.1 Sustainable Development: a historical perspective

The Cambridge (2006) dictionary, states that the word **"sustainable"** is derived from the Latin word ***"Sustinere"*** and means *"to keep in existence, implying permanence, maintaining productivity and long-term long term support."* The Merriam-Webster (2006) dictionary, defines sustainable as: 1: "*capable of being sustained"* and 2: "*of, relating to, or being a method or harvesting or using a resource so that the resource is not depleted or permanently damaged."*

Although the 1987 report, titled "Our Common Future" introduced the whole concept of sustainable development and sustainability reporting, it was not until the Rio Summit, that the first big strides to achieving this were made. The 1987 report defined Sustainable Development "*as such development that meets the needs of the present without compromising the ability of future generations to meet the needs of others" (*WCED, 1987, 8).

The Rio Earth Summit of 1992 resulted in increased attention being given to sustainable development, reflecting growing concern by the public and policy makers over environmental trends. Thus it could be said that indicators represent an attempt to quantify these trends and to determine if the widespread perception that the environmental conditions are deteriorating is indeed correct. Therefore one could argue that sustainable development is a complex matter, in that it incorporates social, cultural, economic and environmental factors and the effects each has on the others.

Shultink (1992) defines sustainable development as *"the development and management of natural resources to ensure or enhance the long-term productivity capacity of the resource base and improve the long-term wealth and well-being derived from alternate resource use systems, with acceptable environmental impacts."* Goodland and Ledoc (1987) define sustainable development as *"a pattern of social and structured economic transformations (i.e. development) which optimizes the economic and social benefits available in the present, without jeopardising the likely further potential for similar benefits in the future."* They also argue that a primary goal of sustainable development is to achieve a reasonable (however defined) and equitable distributed level of economic well-being that can be perpetuated continually for many human generations. In order to achieve this they argue that sustainable development implies using renewable resources in a manner which does not eliminate or degrade them, or otherwise diminish their usefulness for future generations. Sustainable development also implies depleting non-renewable energy resources at a slow enough rate so as to ensure the high probability of an orderly society transition to renewable energy sources.

Munasinghe and Lutz (1991) say that sustainable development is an approach that will permit continuing improvements in the quality of life with a lower intensity of resource use, thereby leaving behind for future generations an undiminished or even enhances stock of natural resources and other assets. Repetto (1986) says the core of the idea of sustainability is the concept that current decisions should not impair the prospects for maintaining or improving future living standards. This implies that our economic systems should be managed so that we can live off the dividend of our resources, maintaining and improving the asset base. This principle also has much in common with the ideal concept of income that accountants seek to determine: the greatest amount that can be consumed in the current period without reducing the prospects for consumption in the future. This does not mean that sustainable development demands the preservation of the current stock of natural resources or any particular mix of human, physical and natural assets. As development proceeds, the composition of the underlying asset base changes.

The Institute of Directors (IOD, 2001) suggests that in a corporate context, “sustainability” means that each enterprise must balance the need for long-term viability and prosperity – of the enterprise itself and the societies and environment upon which it relies for its ability to generate economic value – with the requirement for short-term competitiveness and financial gain. However one of the biggest challenges of sustainability is getting buy-in and getting organisations and people to make coherent plans. One process that has been developed to address this is “The Natural Step” which is a holistic, consensus-based approach to making change happen. The Natural Step enables organisations to create optimal strategies for dealing with the current situation by incorporating a perspective of a sustainable future (Robèrt, 1989). Faludi (2006) says that Robèrt, the founder of The Natural Step, came to the conclusion that there were four principles of sustainability:

i. *Eliminate our contribution to systematic increases of substances from the Earth’s crust into the ecosphere.*
ii. *Eliminate our contribution to systematic increases in concentrations of substances produced by society.*

iii. *Eliminate our contribution to systematic physical degradation of nature through over harvesting, depletion, foreign introductions and other forms of modification.*

iv. *Contribute as much as we can to the goal of meeting human needs in our society and worldwide, going over and above all the substitution and dematerialisation measures taken in meeting the first three objectives.*

From the definitions given, one could argue that that the preconditions of environmental sustainability are rarely being met. This suggests that humans are moving away from, rather than towards, sustainability despite growing recognition of the problem. This recognition is shown in the number of international conventions, legislations and agreements with regard to environmental protection, many of which South Africa is a signatory to. A list of some of these is shown in Appendix A.

In 1987 the World Commission on Environment and Development (WCED), also known as the Brundtland Commission released a report titled "Our Common Future" and was aimed at finding ways of addressing environmental and developmental problems of the world. The three objectives of the commission were:

1. To re-examine the critical environmental and development issues and to formulate realistic proposals for dealing with them.
2. To propose new forms of international co-operation on these issues that will influence policies and events in the direction of needed changes; and
3. To raise the levels of understanding and commitment to action of individuals, voluntary organisations, businesses, institutes and governments.

It could be said that from this document, the concept of the broadening of reporting performances by business as well as the idea of using "indicators" as a measure of a balanced business or society were conceived. This will be discussed in detail further on, as internationally, both governments and business realised the necessity of adopting such an approach and in some cases implemented laws to such effect or required them in order to achieve "good corporate governance."

The Brundtland Commission paved the way for the UN Conference on Environment and Development (UNCED), commonly referred to as the Earth Summit, held in Rio de Janeiro, Brazil in June 1992. At this conference, at least seven major agreements were produced, namely:

1. Agenda 21 – a global plan of action for sustainable development, containing over 100 program areas, ranging from trade and environment, through agriculture and desertification, to capacity building and technology transfer i.e. in every area when humans impact on the environment;
2. The Rio Declaration on Environment and Development - a statement of 27 key principles to guide the integration of environment and development policies (including the polluter pays, prevention, precautionary and participation principles);
3. The Statement of Principles on Forests – the first global consensus on the management, conservation, and sustainable development of the world's forests;
4. The Framework Convention on Climate Change – a legally binding agreement to stabilise greenhouse gases in the atmosphere at levels that will not upset the global climate;
5. The Convention on Biological Diversity – a legally binding agreement to conserve the world's genetic, species, and ecosystem diversity and share the benefits ot its use in a fair and equitable way;
6. The Commission on Sustainable Development (CSD; and
7. An agreement to negotiate a world desertification convention.

(UNCED, 1992)

One of the stipulated fundamentals of the summit was what is today known as the 'precautionary principle.' This principle implies that *"action to protect the environment against the danger of severe and irreversible damage need not wait for rigorous scientific proof"* (Weiss, 2003:137). The concept of sustainable development was reiterated in the World Conservation Strategy (WCS) document released in 1980 by IUCN which stated: *"This is a kind of development that provides real improvements in the quality of human life and at the same time conserves the vitality and diversity of the Earth. The goal is development that will be sustainable. Today it may seem visionary but it is attainable. To more and more people it also appears our only rational option."* (IUCN, UNEP and WWF, 1980).

2.2 Business's response to Sustainable Development

Lotz (2005), stated; *"In the debate on how to achieve sustainable development, industry plays a paradoxical role. On the one hand, it is one of the major productive, wealth creating sectors of society; and on the other hand, it is a major polluter and resource consumer."* She went on to draw attention to the fact that by consuming resources at a faster rate than they can be replenished, there are many hidden costs that are drawing humans into a myriad of social, ecological and economic crises. The World Resources Institute (WRI) states that *"businesses provide goods and services that meet essential human needs, create employment and wealth in communities, and produce technologies that enhance the quality of life and productivity of the economy*" (WRI, 2006). However these often come at the expense of the environment and social conditions.

As organisations react to deal with environmental concerns, growing public pressure and regulatory measures, they have to change the way they do business. Consumers and shareholders are increasingly demanding environmentally friendly products and services that are delivered by socially responsible companies. It is becoming increasingly important for organisations to demonstrate that not only their philosophies but also their investment strategies and day-to-day operations are sustainable (European Commission, 2006). In South Africa, this is demonstrated in the King Report on Corporate Governance of South Africa ("King II") which recommends that companies should report on certain non-financial issues. At the introduction of the King II report, the following is stated: *"Corporate citizenship is the commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve their quality of life"* (IOD, 2001).

Some may argue that some of the recommendations made by King II are controversial and in some cases vague, and are likely to become "ethical values," which will be unenforceable and thus green washing in reports could take place. Green washing can be described as 'disinformation disseminated by an organisation so as to represent an environmentally responsible image' (Lotz-Sisitka, 2005). Visser and Sunter (2002) have stated that profitability used to be a trustworthy financial measure, which has now *"multiplied into a triple bottom line by blurring together economic, social and environmental performance"* (Visser & Sunter 2002:18).

Sustainable development is achieved where the three pillars of sustainability, economic, social and environmental, overlap and that for this to happen, an organisation must have a clear understanding of what is required to achieve this. Sustainable development requires total commitment by all senior management of an organisation for it to be implemented successfully. The global trend is for organisations to embrace the principles of sustainability and for them to require compliance in this regard from their suppliers. Today one could argue that business and industry have acknowledged that environmental and sustainability issues are not the threats they were perceived to be, but can actually be used as sources of competitive advantage if embraced and environmental impact reducing projects and programs instituted.

Arguably, one could apply the Porter hypothesis (Frohwein and Hansjürgens, 2005) to give backing and credence to this interpretation. According to the Porter Hypothesis, strict environmental regulations can induce efficiency and encourage innovations and help improve commercial competitiveness. According to this, strict environmental regulation triggers the discovery and introduction of cleaner technology and environmental improvements, known as the innovation effect. These help make production processes and products more efficient. The cost savings achieved are sufficient to compensate for both the compliance costs directly attributed to the regulations and the innovation costs. Thus if a business applied this theory and gained a first mover advantage, it will be able to exploit innovation by learning curve effects or patenting and attain a dominating competitive position compared to companies in countries where similar environmental regulations come into force later (Frohwein and Hansjürgens, 2005). One could say that this theory is further backed by Elkington (1994) and Schmidheiny (1992) who advocate that environmentalism can be an opportunity for business.

For decades, economic growth has been considered the principle indicator of a healthy society. It is only recently, that society has begun to realise the environmental cost of this growth. *"There is now an urgency to develop the means of satisfying present needs without compromising the ability of future generations to meet theirs"* (Oliver, 1996). Economic vitality, employment creation and environmental protection are now recognised as being strongly interrelated, and business continues to be an integral contributor to all three, not only in terms of external relations with its customers, shareholders, governmental authorities and the community, but also in its own facilities and places of business.

To date, the implementation of sustainable management initiatives within organisations has largely been reactive, responding to environmental pressures, legal obligations, risk management, customer demands and competition. However for this to be successful, management needs to break away from "traditional" practices and change the values and philosophy of their organisations to overcome the number and complexity of organisational issues that overlap with society. All the role factors such as the environment, society, organisation, suppliers and customers need to be taken into account and policies developed to ensure that sustainability in both the short and long terms are achieved.

Business , from resisting change and operating under what were known as command and control approaches, which today are viewed as a *"crude first generation strategy"* (Ackerman and Stewart, 1985. 1338), have moved towards adopting new mechanisms for reducing their environmental impact. The 'command and control' approach referred to a public policy approach that relied on centralised regulatory commands to implement environmental goals. Command and control imposed liability on those who did not meet minimum standards. This approach failed to provide incentives or guidance for firms seeking to assume higher levels of environmental responsibility (Zondorak, 1991). Due to public pressure, business responded by subscribing to voluntary environmental management programs that addressed these issues.

In brief, one could say that the definition as given by the International Institute for Sustainable Development (IISD,1992) that states *"For the business enterprise, sustainable development means adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining and enhancing the human and natural resources that will be needed in the future"* (IISD, 1992), is the approach that should be accepted and embraced by business entities. With regard to environmental sustainability practices, there are a number of tools that businesses can use to help identify and improve on the most important issues highlighted.

2.3 Tools that contribute to sustainable development in industry

2.3.1 Environmental Management Systems

The International Standards Organisation (ISO) defines an Environmental Management System (EMS) as: "… *that part of the overall management system which includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing achieving reviewing and maintaining the environmental policy*" (ISO, 2005). The US EPA (2006), states that *"a commitment to preventing pollution is the cornerstone of an effective EMS and should be reflected in an organisation's policy, objectives and other EMS elements."* From this statement, one could argue that improved efficiencies with respect to the use of environmental resources are the key, as less wastage will result in less pollution.

An EMS is a management tool used to continually improve all operations that impact the environment. It identifies goals and enlists the entire workforce in a coordinated effort to achieve them (AGC of America, 2006). Companies are increasing their use of EMS as these systems provide a framework for effective management of environmental obligations, including reduced risk and liabilities; possible eligibility for environmental incentive programs; better public image; and improved operational efficiencies/cost reduction opportunities. An efficient EMS successfully integrates environmental considerations into everyday business operations. This means that environmental stewardship becomes part of the daily responsibility for employees across the entire organisation, and not just in the department tasked with this sphere of operations.

EMS have been developed in response to the "root causes" of poor environmental management and compliance problems by business, which has recently been brought into the spotlight as the concept of sustainable development becomes more widely accepted and embraced. One could say that an EMS has corollary benefits of management systems to mission and environmental stewardship. It could also be argued that all businesses have some type of EMS, regardless of what they do, in an effort to minimise costs. Therefore an EMS is a more formalised, recognised, and structured approach of adopting and implementing an accepted EMS framework. In most cases, this requires additional effort to make the transition from current environmental programs to a more formal EMS which enables environmental concerns to be prioritised. This is where many organisations seemingly find themselves faced with an enormous hurdle as the actions required for system development and implementation seem ill defined, at best. This results in a loss of enthusiasm and discipline that is required to accomplish their EMS objectives. Thus many agencies, experienced in implementing EMS have found that developing an effective EMS Implementation Plan is the key to success (Pendleton and Nagy, 2002).

An EMS should include strategic planning activities, the organisation's structure and implementation of the environmental policy as an integrated part of the manufacturing process. The environmental policy is an organisation's declaration of commitment to the environment. Thus it should serve as the foundation of the EMS and provide a unifying vision of environmental concern by an entire organisation. This environmental policy serves as the framework for setting environmental objectives and targets and as such should be included when an organisation discusses strategy. It should contain three key elements including a commitment to continual improvement (Figure 2.1). Within an organisation, the policy should be related to its products and services, as well as supporting activities (KPPC, 2006).

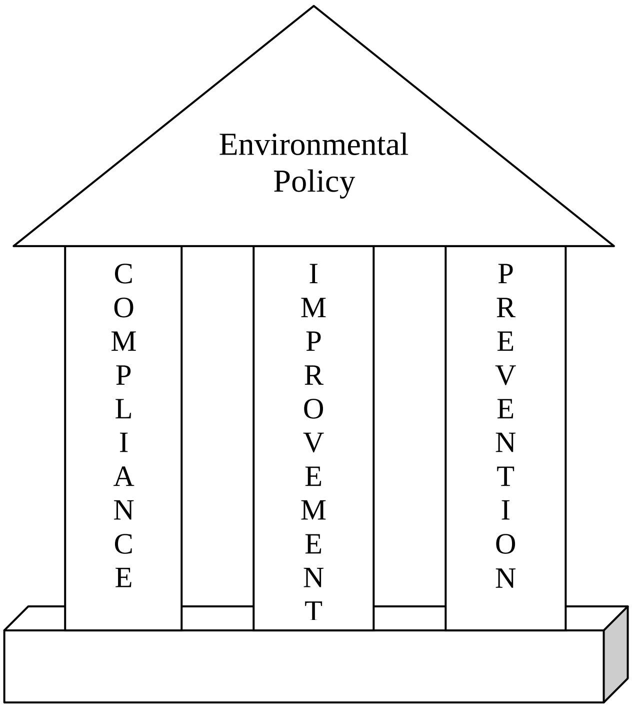

Figure 2.1: The Three Pillars of an Environmental Policy

There are a number of EMS and generally one could say that they all have the same objective of providing good environmental management, although they are often seen as competitors (European Commission, 2006). One of the best known is the ISO family of management systems. Closely linked to these are the Eco-Management and Audit Scheme (EMAS), advocated by the European Union (EU). The emergence of ISO 14001 has helped EMAS in terms of raising general awareness of environmental management schemes. Whilst the two systems are complementary, EMAS is more rigorous in some areas and as a result is often regarded in a more prestigious light (European Commission, 2006). Whatever system is used, they all have the same main function of managing environmental risk.

2.3.1.1 The International Organisation for Standardisation

In response to the needs of governments, businesses and societies, an organisation, named the International Organisation for Standardisation (ISO), was established. It is a global network that identifies what International Standards are required by business, government and society, develops them in partnership with the sectors that will use them, adopts them by transparent procedures based in national input and delivers them to be implemented worldwide. It can be said that ISO standards distil an international consensus from the broadest possible base of stakeholder groups. The ISO is a non-governmental organisation and is a federation of the national standards bodies of some 149 countries (ISO, 2005).

In particular the ISO 9000 and 14000 families of management systems standards have spearheaded a widening of ISO's scope to include managerial and organisation practice. The ISO 9000 family is primarily concerned with "quality management." The ISO 14000 family is primarily concerned with "environmental management." This means what the organisation does to:

- Minimise harmful effects on the environment caused by its activities, and to
- Achieve continual improvement of its environmental performance.

ISO 14000 is the result of an initiative to bring a host of EMS under a common umbrella. The ISO 14001 EMS has been developed as a mechanism to improve the internal management of environmental issues in an organisation and thereby create opportunities to improve its environmental performance. However for the potential benefits of ISO 14001 to be realised, the manner in which the standard is implemented and the scope of its use in a regularity framework, must support its initial objectives. Both ISO 9000 and ISO 14000 are particularly important tools for aiding exporters from developing countries as they provide internationally recognised seals when approaching new customers (ISO, 2005)

2.3.1.2 Eco-Management Audit Scheme

The EMAS system allows voluntary participation in an environmental management scheme for organisations operating in the EU and European Economic Area. It recognises much of what is covered in the ISO standards, but differs from the ISO standards in that it requires organisations to:

- undertake an initial environmental review;
- actively involve employees in implementing EMAS;
- make available relevant information to the public and other parties;

A comparison of the two standards and their differences is shown in Table 2.1

Table 2.1 Comparison between EMAS and ISO 14001

	EMAS	ISO 14001
Preliminary environmental review	Verified initial review	No review
External Communication and verification	Environmental policy, objectives, environmental management system and details of organisation's performance made public	Environmental policy made public
Audits	Frequency and methodology of audits of the environmental management system and of environmental performance stated	Audits of the environmental management system required (frequency or methodology not specified)
Contractors and suppliers	Require influence over contractors and suppliers	Relevant procedures are communicated to contractors and suppliers
Commitments and requirements	Employee involvement, continuous improvement of environmental performance and compliance with environmental legislation	Commitment of continual improvement of the environmental management system rather than a demonstration of continual improvement of environmental performance

(European Commission, 2006).

2.3.1.3 Benefits of implementing an EMS

There are many benefits that can accrue to an organisation implementing an EMS and include:

- quality environmental management due to the use of a highly developed scheme
- contribution to environmental risk management of the organisation
- resource savings and lower costs according to the organisation's needs
- reduction of financial burdens due to reactive management strategies such as remediation, clean-ups and paying for penalties for breach of legislation
- financial benefits through better control of operations
- incentive to eco-innovate production processes while environmental impacts are rising world-wide
- compliance check with environmental legislation
- learn from good examples of other companies and organisations
- new business opportunities in markets where green production processes are important
- added credibility and confidence with public authorities, other businesses and customers/citizens
- improved relations with the local community
- improved quality of workplaces, employee moral and incentive to team building
- marketplace advantage and improved company image by improving stakeholder relations

(European Commission, 2006).

From the benefits given, one could argue that these show that there will be financial benefits for an organisation that successfully implements an EMS as well as social benefits, thus contributing to the three pillars of sustainability. These systems also introduce the concept of eco-efficiency.

2.3.2 Eco-efficiency

Eco-efficiency was first coined by the World Business Council for Sustainable Develpment (WBCSD) in 1992 and defined as *"the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle to a level in line with the earth's estimated carrying capacity* (WBCSD, 1996). Advocates of eco-efficiency argue that it is needed for the simultaneous satisfaction of the rising consumption of a growing global population and attainment of reasonable environmental quality (Huppes and Ishikawa, 2005). From these descriptions, one could say that eco-efficiency is the combination of ecological and economic excellence and makes the link between the environmental and economic pillars of sustainability. It could further be said that eco-efficiency is a subset of sustainability as it does not include issues of a social nature. The concept encourages businesses to:

- produce more with fewer resources and less pollution
- encourages business to become more competitive, more innovative and more environmentally responsible.

Eco-efficiency makes seven demands on companies:

1. Reduce the material intensity of goods and services;
2. Reduce the energy intensity of goods and services;
3. Reduce toxic dispersion;
4. Enhance material recyclability;
5. Maximise sustainable use of renewable resources;
6. Extend product durability;
7. Increase the service intensity of goods and services.

(ICC, 1998).

The WBCSD (1997), in its book *"Eco-efficiency, The Business Link to Sustainable Development,"* identifies five core themes of eco-efficiency:

1. an emphasis on service.
2. a focus on needs and quality of life,
3. the consideration of the entire product life cycle,
4. a recognition of the limits of eco-capacity, and
5. a process view.

"Eco-efficiency is fundamentally a ratio of some measure of economic value added to some measure of environmental impact" (Ehrenfeld, 2005). In layman's terms it could be described as a ratio between two elements: environmental impact, to be reduced, and the value of production, to be increased. Huppes and Ishikawa (2005) state that *"the value of production lies in the products produced, comprising both goods and services."* The challenge of applying eco-efficiency in practice is the same as the challenges of life-cycle assessment (LCA) in that one needs to know *"how to set system boundaries, temporal and spatial scale phenomena, and functional unit definitions"* (Brattebø, 2005).To reduce these challenges, one can apply eco-efficiency analysis to a local facility scale, or at a corporate scale including only those production units controlled by a firm. According to Ehrenfeld (2005) eco-efficiency calculations could be used to:

- Choose among alternative processes and products (microscale);
- Evaluate the performance of a company or other organisational entity;
- Evaluate the performance of a country, region, or other macroentity.

The concepts of eco-efficiency and Cleaner Production are almost synonymous. The difference being that eco-efficiency starts from issues of economic efficiency (value creation) which have positive environmental benefits, while Cleaner Production starts from issues of environmental efficiency (production) which have positive economic benefits (UNEP, 2001).

2.3.3 Cleaner Production

Used in conjunction with other elements of environmental management, cleaner production is a practical method for protecting human and environmental health, and for supporting the goal of sustainable development (BSD, 2006 On-line). The UNEP has been active in cleaner production since 1989 when a decision was made to address environmentally sound technologies. The Cleaner Production Program was launched in 1990 and since then further activities have been undertaken (UNEP, 1994). On September 10, 1999, 159 organisations with high-level representation, signed the UNEP International Declaration on Cleaner Production. The declaration starts off by stating, *"We recognise that achieving sustainable development is a collective responsibility. Action to protect the global environment must include the adoption of improved sustainable production and consumption practices"* (UNEP, 1999a. on-line). UNEP defines cleaner production as *"the continuous application of an integrated preventative environmental strategy applied to processes, products and services to increase eco-efficiency and reduce risks to humans and the environment"* (UNEP, 2000. on-line). In terms of industry, one could say that business does not operate in isolation, but responds to the business environment as a whole and especially to signals or indicators that are perceived to be having either beneficial or adverse effects on it. From these threats and opportunities, business shapes its behaviour. The Cleaner Production assessment methodology as advocated by UNEP can be used to systematically identify and evaluate any Cleaner Production opportunities within an organisation and facilitate their implementation (UNEP, 2001).

There are four elements of cleaner production, which are:

1. The precautionary approach – potential polluters must prove that a substance or activity will do no harm;
2. The preventative approach – preventing pollution at the source rather than after it has been created;
3. Democratic control – workers, consumers, and communities all have access to information and are involved in decision-making;
4. Integrated and holistic approach – addressing all material, energy and water flows using life-cycle analyses

(IISD, 2006 on-line).

Thus cleaner production requires a new way of thinking about processes and products, and about how they can be made less harmful to humans and the environment. Within an organisation, this requires total buy-in by management and for the concept to be effectively communicated to employees at all levels with their involvement in the process. The following guidelines can be used to implement a cleaner production approach:

1. Identify the hazardous substance to be phased out, on the principle of the precautionary principle;
2. Undertake a chemical/material flow analysis;
3. Establish a time schedule for the phase-out of the hazardous substance in the production process, as well as its accompanying waste management technology;
4. Implement and further develop cleaner production processes and products;
5. Provide training, technical and financial support;
6. Actively disseminate information to the public and ensure their participation in decision-making;

7. Facilitate substance phase-out with regulatory and economic incentives;
8. Facilitate the transition to cleaner production with social planning, involving workers and communities affected

(IISD, 2006 on-line).

These guidelines also illustrate the difference between cleaner production and eco-efficiency in that cleaner production benefits all three legs of sustainable development, whilst eco-efficiency only benefits the economic and environmental legs. It can be seen that cleaner production is about the prevention, rather than the control of pollution. Therefore its activities include measures such as pollution prevention, source reduction, waste minimisation and eco-efficiency. All these imply that there is a need for better management and housekeeping within organisations with the aim to substitute as many toxic and hazardous materials as possible, modify processes to achieve less consumption and waste production and to recycle as much as possible. Whilst implementing cleaner production may not solve all environmental problems at a facility, it is a step towards reducing their impact on the environment.

The establishment of benchmarks against which futures studies or comparisons can determine the rate of uptake of cleaner production by industry or business is an important part of the development of a strategy to promote cleaner production. However, benchmarks of cleaner production are not an end in themselves as although they enable comparisons between industry sectors, they do not explain differences in performance. This indicates that benchmarks should be used as a guide to search for these differences and explanations (Dempster *et al.*, 1997). The benefits to an organisation implementing a cleaner production program include less waste, the recovery of valuable by-products, improved environmental performance, increased resource productivity, increased efficiency, lower energy consumption, and an overall reduction in costs. By demonstrating a commitment to cleaner production, organisations can also improve their public image and gain the confidence of consumers which might result in greater competitiveness. Organisations wanting to implement cleaner production or eco-efficiency strategies should use life-cycle analysis as a means of identifying and prioritising those processes and products that have an impact on the environment.

2.3.4 Life-cycle analysis

Life-cycle analysis defined as *"assessing the environmental impact of a product or service through its entire life – including any recycling and final disposal"* (ICC, 1998), is a further important response by business and industry to the challenges of sustainable development. The concept of conducting a detailed examination of the life cycle of a product or a process is a relatively recent on which emerged in response to increased environmental awareness on the part of the general public, industry and governments (World Resource Foundation, 2006). The developing science of life cycle approaches, which list and weigh trade-offs between positive and negative environmental aspects of a specific product of process, can help improve products' quality and environmental impacts (ICC, 1998). The issue is not one of how much is being consumed in any absolute, material sense, but to strive as companies, to continually improve resource efficiency while reducing environmental impacts. Life cycle approaches can be extended and shared through partnership with joint venture parties and suppliers and contractors.

The LCA can provide the information necessary to quantify areas where the greatest improvements can be made and provide value in research, technology, and design decision making. It can help provide the least environmentally impactive product, whilst maximising profits. It will ensure to the extent possible "hidden costs" of environmental damage can be accounted for and reflected. Thus the LCA is a potentially powerful tool that can help manufacturers analyse their processes and improve their products, and perhaps enable consumers to make more informed choices. However it must be used correctly and care needs to be taken to avoid it being used to 'prove' the superiority of one product over another (World Resource Foundation, 2006).

Life cycle analysis facilitates a systems view in environmental evaluation of products, materials and processes (Joshi, 2000). The ICC Charter is explicit in its discussion of the use of the life cycle assessment within organisations, saying that companies should *"conduct or support research on the environmental impacts of raw materials, products, processes, emissions and waste associated with the enterprise"*(ICC, 1993 46A1). Life-cycle analysis *"is an approach to understanding the potential environmental impacts of a product through its life cycle from raw material extraction to final product dispersal"* (Brown, 1998). The literature review showed that the process of environmental improvement must start with a comprehensive measure of current performance which requires that a baseline of environmental information is compiled. Life cycle analysis is a technique which is well suited to these tasks (Frears and Boyd, 2004). At every stage of the life cycle there are emissions and consumptions of resources. Thus LCA is a tool for the systematic evaluation of the environmental aspects of a product or service system through all stages of its life cycle (Figure 3.1)

There are four phases involved in implementing a LCA (Figure 3.2):

1. Goal and scope definition: This phase includes determining the purpose of the study and stating it in clear terms. It also requires a description of the system to be studied, the intended use of the study and any limitations that may have been identified (Brown, 1998). An example of goal would be the quantification of energy, raw materials, air emissions, waterborne effluents and solid wastes incurred by a particular system (Frears and Boyd, 2004).

2. Inventory phase or analysis: involves drawing up a list of environmental inputs, such as raw materials and energy, and outputs including emissions to air, water and land (Brown, 1998). The energy and raw material requirements and environmental emissions of the product, process or activity are quantified (Duda and Shaw, 1995).These should be catalogued at each stage in the life of a product (Portney, 1994). There are a number of key steps in inventory analysis (Figure 3.3), so it s important that the researcher has a clear idea about exactly what categories of data need to be collected (part of the scoping exercise), and how this data will be collected.

The inventory analysis is only as good as the input data which implies that the following considerations need to be made:

- its age
- whether it is aggregate
- whether it was estimated or actually measured
- its completeness.

(Frears and Boyd, 2004).

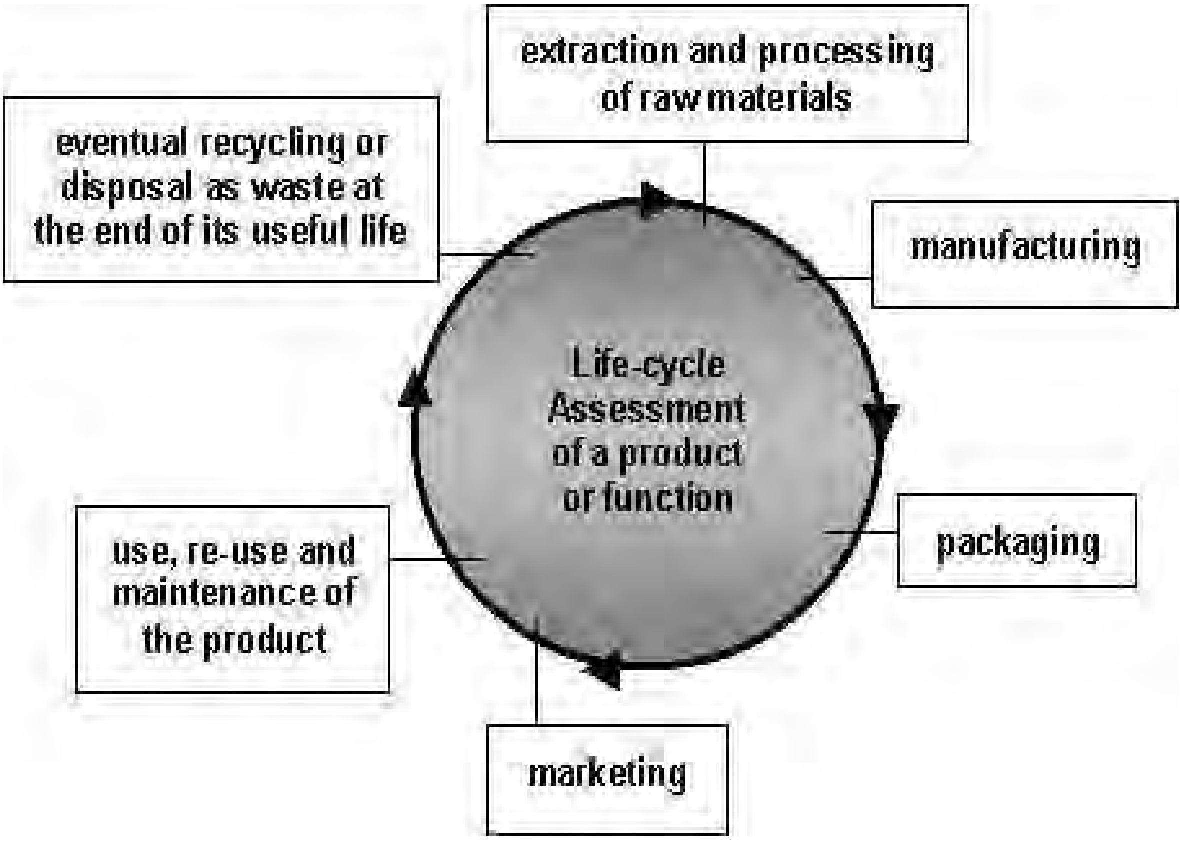

Figure 2.2: Life cycle assessment of a product (Source UNEP, 2003)

3. Impact assessment: an inventory review and evaluation of the potential resource depletion, health and environmental consequences (Brown, 1998). This assessment translates the physical effects cataloged into actual damage done to human health and to aquatic and terrestrial ecosystems (Portney, 1994). This is done by classifying the inventory into “stressor” groups or “sets of conditions that may lead to an impact.” Stressors are then prioritised according to the perceived severity of their impacts (Duda and Shaw, 1995). This analysis makes it possible to draw useful comparisons among the differing emissions that result from different products or from different ways to manufacture, distribute,use, and dispose of the same product (Portney, 1994). There are a number of key stages in the LCA impact assessment phase (Figure 3.4) 4. Improvement/interpretation: This is the determination of the meaning and evaluation of the system (Brown, 1998). Recommendations are made based on the results of the inventory and impact phases. These recommendations may include modifying a production process, using different raw materials, or choosing one product over another (Duda and Shaw, 1995). The incorporation of economics into the life cycle analysis is step towards a better understanding of the true cost of waste. Conventional accounting records show the cost of waste disposal, but typically as the cost of treatment or off-site disposal. Such costs do not include those of raw

materials, utilities, and other operating factors associated with the production of waste, nor do they account for the capacity tied up in its production (Stern, 1995).

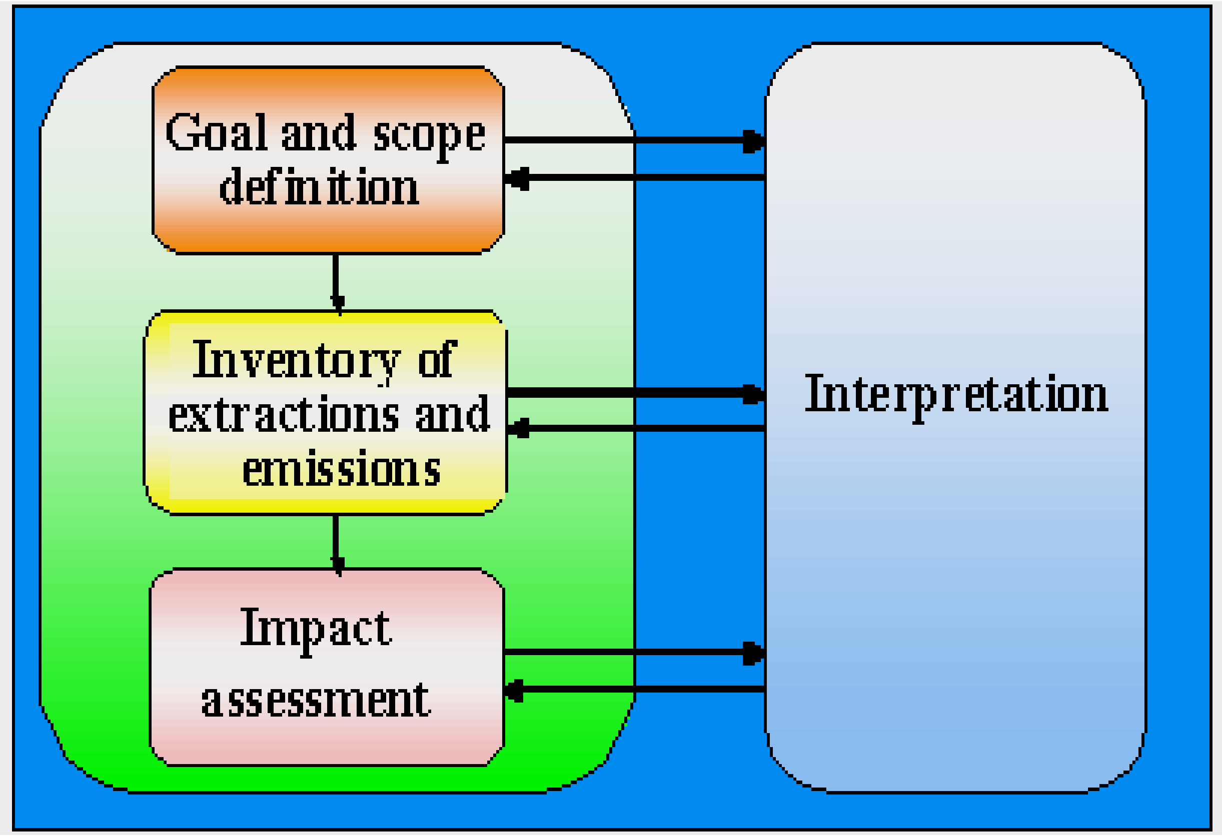

Figure 2.3: Four phases in implementing LCA (Source UNEP, 2003)

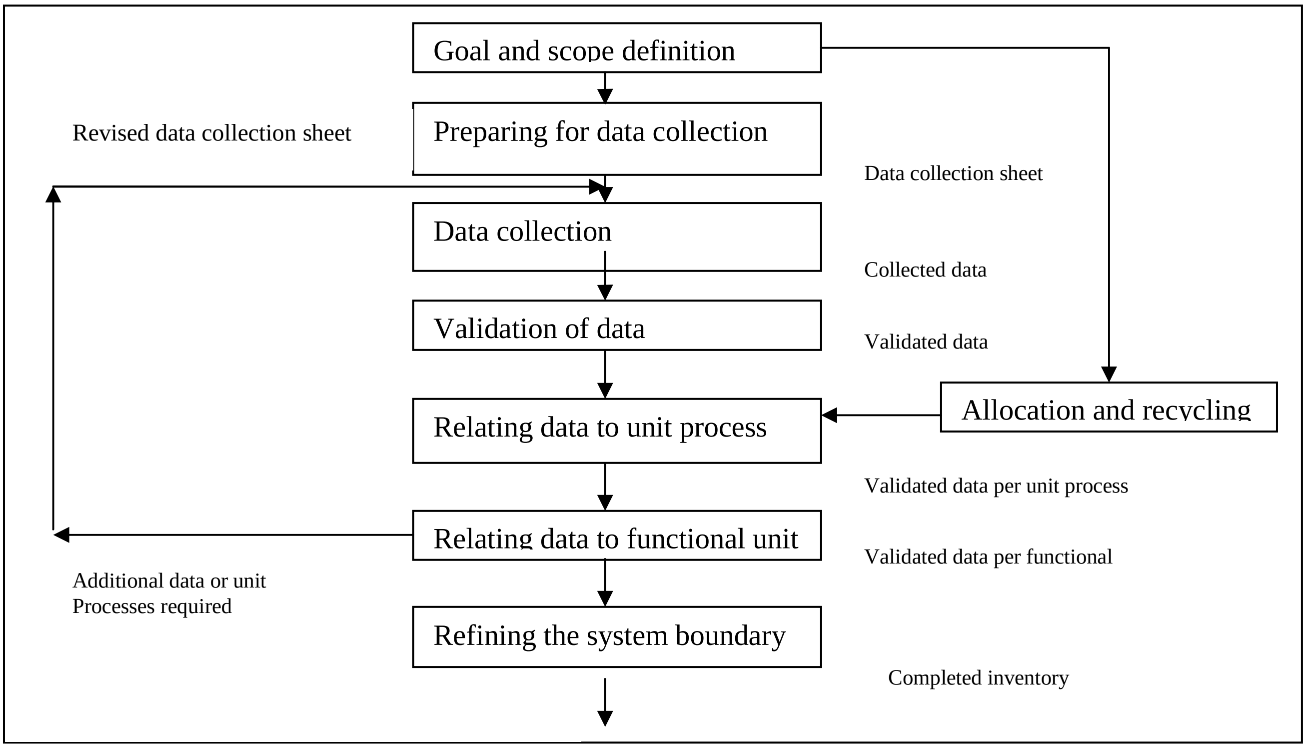

Figure 2.4; Key steps in inventory analysis (Source: Frears and Boyd, 2004).

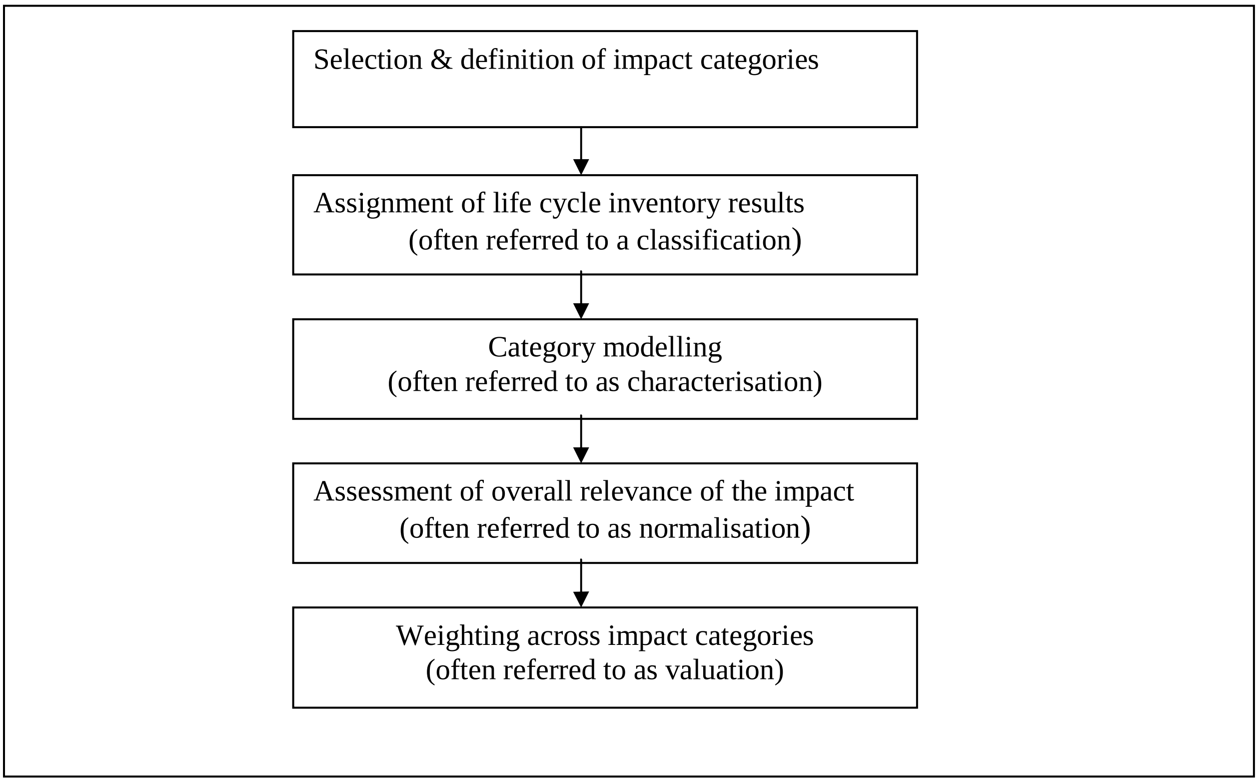

Figure 2.5: Key stages in impact assessment (Source: Frears and Boyd. 2004).

2.4 Sustainable development in the Agro-processing sector.

2.4.1 International trends

The world population will grow from six billion in 1999 to almost nine billion in 2050, and this population must be fed. The whole agri-food chain which is involved in the production of agricultural products, of food transformation, food distribution by the retail chains, and consumption has major environmental impacts (UNEP, 2001a). This is illustrated in Figure 2.2 The food and beverage industry (FBI) has acknowledged the need to achieve sustainable development and many food companies today adhere to the Business Charter for Sustainable Development of the International Chamber of Commerce since its publication in 1991(CIAA, 2002). The FBI is a significant user of resources (water, energy, packing materials), and a generator of wastewater, gaseous emissions, organic residues and packaging wastes. It has been estimated that 1 kg of produced foods or beverages can generate between 5 kg and 50 kg of residues. Organic wastes from the food industry account for a significant part of wastes generated by industrial, commercial and institutional sector and value adding is not yet sufficiently well developed by the industry (Maxine *et al.*, 2006).

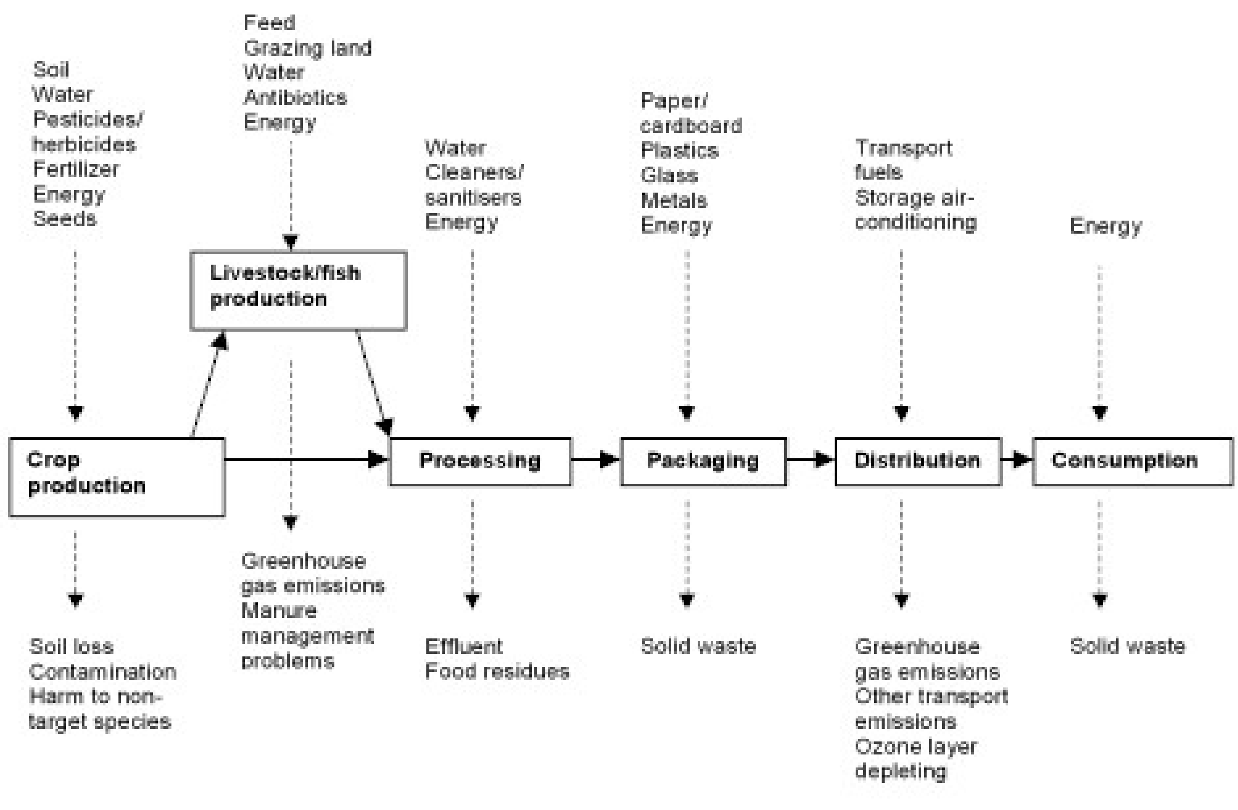

Figure 2.6 Diagram of the Agri-food life cycle (Source: UNEP,2001a).

Water and waste water management constitutes a practical problem for the food and beverage industry including the pineapple industry. Water consumption is not only an economic parameter but can also be used as a tool to determine process performance (Fillaudeau *et al.*, 2006). Water plays a major role in the manufacturing processes as well as for cooling, condensation, steam production and the disposal of certain wastes. The Australian FBI industry reports a range of water consumption from 3 l/kg of products for food in general to 33 l/kg for meat processing (CIAA, 2002). By virtue of their extensive diversification, FBI companies generate effluents that vary greatly in quantity and quality. These effluents do share certain characteristics, including high organic content (proteins, carbohydrates and lipids), high chemical or biochemical oxygen demand (COD or BOD) and, occasionally high nitrogen concentration (Maxine *et al.*, 2006).

In an effort to reduce use and wastage, many companies have instituted measures to limit the amount of water consumed such as the starch industry which has achieved savings of up to 20% during the last 20 years due to process integrated measures and internal recycling of process water. Cooling water systems have been optimised to reduce cooling water requirements and the use of fresh water (CIAA, 2002).

With regard to the actual manufacturing or processing of raw agricultural products into finished products, many firms have been applying the principles of eco-efficiency. It is sometimes necessary to invest capital in the short term in order to achieve eco-efficiency in the long-term, such as Nestlé who are reported to spend Sfr 100 million annually worldwide on environmental issues (CIAA, 2002). The FBI has recognised the fact that in order to manage environmental performance, it must first be measured. Areas of operations being looked at to reduce their environmental impact include water, energy, air emissions, by-products/waste, packaging and transport. (CIAA, 2002).

In terms of social aspects, international companies are responding by lobbying for worker rights (Levi Strauss) to be written into international trade agreements or by buying fair-trade products such as coffee (Starbucks) in response to consumer demands (Mathew, 2005). Some countries impose import tax levies and or quotas on product from selected countries that can be imported in an effort to not only protect their own interests but in some cases to give developing countries a slight advantage by being able to sell at lower prices due to not having to pay these duties. In some countries, efforts are made to buy product that has either been grown in an environmentally friendly way or where a premium is paid (e.g. Fair Trade) which directly benefits identified sectors of the community that need it most(Duncan, 2006).

Agri-food processing organisations are responding to these requirements by implementing EMS and subscribing to other quality standards such as the European Food Safety Inspection Standard (EFSIS), the British Retail Consortium (BRC) standard and the Hazard Analysis Critical Control Point (HAACP) standard. These systems and standards assure customers that the product they buy has been processed in a responsible manner and that areas of environmental concern are taken into consideration (Eldridge, 2005).

Agricultural inputs into foods that are processed are also coming under the spotlight, with customers demanding that the suppliers of raw food stuffs for processing comply with certain standards. In some cases agro-food processing companies have worked closely with their raw material suppliers to reduce their impact on the environment e.g. Unilever's Birds Eye Walls, began a sustainable agriculture project for peas growers in the United Kingdom (CIAA, 2002). In other instances, processors require their raw material suppliers to comply with certain accredited standards such as EUREPGAP (Mostert, 2005).

2.4.2 Sustainable development in the pineapple processing industry

2.4.2.1 Introduction to the pineapple industry

The pineapple is native to South America, but once its drought tolerance and ease of transport of vegetative propagules were recognised, the world-wide diffusion of pineapples around the world occurred. The first commercial products of pineapple, namely jams and sweets were made in the West Indies, Brazil and Mexico (Bartholomew *et al.,* 2003: 2). Commercial processing into glass jars or cans started in Hawaii at the end of the 19th century. The invention and refinement of the automatic peeling and coring machine, in Hawaii, by Henry Ginaca, between 1911 and 1919 allowed for the development of a large-scale economically viable canning industry. This was then paralleled by a major expansion of pineapple production. It is interesting to note that no additional significant improvements have been made to this machine since 1925 (Anon., 1993).

Processing of pineapple, started in South-East Asia in the early 1900's followed by Australia, South Africa, the Caribbean, Kenya and Swaziland (Bartholomew *et al.*, 2003). The processing of pineapple has made the fruit well known throughout the temperate developed world. A wide variety of styles of product may be packed from pineapple. The standard ones are listed in the excerpt from the Codex standards for canned pineapple (Codex Alimentarius Commission, 1995). Major processed pineapple products of the international trade are canned slices, chunks, crush (solid pack) and single strength or concentrated juices.

The main producers of processed pineapple are Thailand, the Philippines, Indonesia, Malaysia, China, Australia, Kenya, South Africa and Swaziland. Smaller operations occur in Central and South America and Hawaii (Table 2.2). Whilst seventy percent of the pineapple produced in the world is consumed as fresh fruit in the country of origin, there is a sizeable international market in processed fruit, which is dominated by a few multinational companies that have developed the infrastructure to process and market pineapple.

There are very few comprehensive books on pineapple, with only two being published in the past twenty five years, namely The Pineapple, published in French in 1983, then translated and published in English in 1987, followed by The Pineapple; Botany, Production and Uses edited by Bartholomew *et al*, which was published in 2003. A literature review of these books plus of journals and experimental findings did not reveal any reference to sustainable development or strategy in pineapple production or processing thereof. To a degree the international pineapple community have recognised the lack of readily available information and in an effort to share and spread knowledge, hold an International Pineapple Symposium every three years at different venues throughout the world. To date these symposiums have concentrated on the growing of and research on pineapple, while there have been attempts by South African representatives to introduce a section on marketing and hopefully later the processing of pineapples in an effort to establish benchmarks against which all pineapple processing factories can measure themselves. The establishment of benchmarks in the canned food processing industry of South Africa is currently being investigated by the South African Fruit and Vegetable Canners Association (Duncan, 2005).

Table 2.2: 2001 Pineapple production in major processing countries

Country	**Production -tons**
Thailand	2 300 000
Philippines	1 571 904
China	1 284 000
Indonesia	300 000
Kenya	280 000
South Africa	145 441
Australia	140 000
Malaysia	130 000
Swaziland	19 680

(Source: Bartholomew *et al.*, 2003. 5)

2.4.2.2 The pineapple industry in South Africa and sustainable development

Apart from increased pressure due to direct competition, the requirements of clients have also increased in recent times. With Europe being a major market for processed pineapple (Bartholomew *et al.*, 2003), the industry has had to comply with its requirements which include environmental concerns. This is illustrated in an email from Gimperli AG (a federation of Migros Cooperatives), a Switzerland based client to the MD of SPF Ltd on the 10th March 2006, from which the following exerts were taken. *"Migros is traditionally committed to mankind and the environment. Our aim, in collaboration with our suppliers, is continuously to improve working conditions in the production facilities. We will be pleased if you make your own contribution to improving working conditions throughout the world. The federation of Migros Cooperatives will assist you as appropriate with the implementation of corrective measures"* (Duncan, 2006). The Swiss market is currently the most lucrative for SPF Ltd and features prominently in the company's long-term marketing strategy (Duncan, 2005).

Apart from the internationally recognised EMS and food safety and quality standards, the pineapple industry in South Africa, in order to be able to supply the European market has had to have all its raw fruit suppliers EUREPGAP certified. EUREPGAP was an initiative started in

1997 and known by retailers belonging to the European Retailer Produce Working Group. EUREPGAP was driven by the desire to reassure consumers, following food safety scares such as mad cow disease (BSE), pesticide concerns and the rapid introduction of genetically modified foods. Consumers throughout the world were asking how foods are produced and required reassurance that it is both safe and sustainable (EUREPGAP, 2005). Due to the retailers sourcing product from throughout the world, they needed a commonly recognised reference of standard of Good Agricultural Practice which has at its centre a customer focus. These factors reiterate the importance major corporations and multinational supply bases place on ensuring agriculture and the processing of agricultural products is undertaken in a responsible way that respects food safety, the environment, workers welfare and the welfare of animals.

Technically speaking, EUREPGAP is a set of normative documents suitable to be accredited to internationally recognised certification criteria such as ISO Guide 65. Representatives from around the globe have been involved in the development of the EUREPGAP documents. The result was a challenging, yet achievable protocol which farmers around the world can use to demonstrate compliance with Good Agricultural Practices. The Department of Agriculture in South Africa has acknowledged the international trends in this regard and on the 24th May 2002, released an amendment to the Agricultural Product Standards Act, 1990 (Act No. 119 of 1990), which requires all farms in South Africa producing product that will ultimately be exported, to be certified with a local version of EUREPGAP, called the South African Food and Safety Standard for Primary Production Areas. Once certified, a farm is issued with a Production Unit Code (PUC) number, by the Department of Agriculture, which an exporting organisation must be able to produce on request when exporting (Mostert, 2005). The South African standard is virtually identical to EUREPGAP. Due to the large number of farms involved in export, the Department of Agriculture will issue a PUC number to any farm that is already EUREPGAP certified (Department of Agriculture, 2005).

2.4.3 Pineapple production in South Africa

Pineapple production for processing in South Africa occurs in the Eastern Cape with two canneries in operation in East London, namely Summerpride Foods Ltd – processing around 100 000 tons per annum and Collondale – processing around 35 000 tons. Both are extremely important to the economy of the Eastern Cape as they employ sizeable labour forces and contribute indirectly to job creation in the rural agricultural sector. This is crucial in a province where unemployment is high and the economy very sluggish (Duncan, 2005). As SPF Ltd sells the majority of its products on the international market, it is affected by both customer demand and international legislation which it has to comply with.

The pineapple is relatively easy to grow and doesn't require much input in terms of pesticides or fertilizer compared to other crops. In Thailand, which dominates world trade in processed pineapple, production is produced on almost 100 000ha of small farms of 1 -5 ha (Anupunt. 2000) due to it being an easy crop to grow. Production on a large scale is labour intensive with Australia managing to produce around 300 tons per labourer per year and South Africa 150 tons per labourer per year (Scott, 2005). Yields are hard to verify internationally but in South Africa it is around 60 tons per hectare (SPF, 2005). The time from planting to harvest to from 14 months to two years depending on the location of production. A second crop is harvested from the same plants some nine to twenty months later. Planting material is either the top broken off a fruit at harvesting or a slip that has grown on the peduncle of a fruit during development. Flowering is induced by applying artificial hormones by spray in order to spread the crop and to ensure easier harvesting of entire lands (Scott, 2005).

The average farm in South Africa is producing around 3500 of fruit per annum (SPF, 2005). This equates to around 24 labourers per farm or around 900 labourers in total in the industry, with around 60 hectares of pineapple being harvested per farm per annum with another 60 hectares in various stages of growth. Pineapple production in South Africa and Australia is fairly machinery intensive in terms of tractors which are needed for ground preparation, spray applications, harvesting and knock-down. This has resulted in growers being sensitive to both fuel and machinery price fluctuations (Scott, 2005).

Production in South Africa takes place 1000km further away from the equator than any other pineapple producer in the world. This is achievable due to the mixed climate here with both summer and winter rains, along with a temperate climate that is modified by the warm Indian Ocean current along its coast. Production takes place within 50kms of the coast and on average 135kms from East London. Pineapples are transported to East London in bulk bins by road transport. The lower average temperatures, compared to other production areas, experienced in the Eastern Cape make for a slower growing cycle compared to the world average, but the advantage of this is that the fruit harvested has a better taste, especially when processed, compared to fruit grown and processed elsewhere (Duncan, 2005). This taste has been described in both the Swiss and Spanish markets as being the closest to tasting like fresh fruit than from anywhere else. Currently the major markets for Summerpride Foods Ltd are the United Kingdom (UK); Switzerland; The Iberian Peninsula; Australia; Russia; The Canary Islands and South Africa for canned products and Europe and Russia for pineapple juice concentrates (Duncan, 2005).

A disadvantage of selling on the international market, particularly into Europe, is that the processors are vulnerable to exchange rate fluctuations and are selling into markets where inflation is low and stable compared to that of South Africa where inflation is running close to 6% currently (Clayton, 2006). SPF Ltd has managed to manage its direct costs (Figure 2.3) well over the past few years but now needs to look for other areas where efficiencies could result in further savings (Duncan, 2006).

Figure 2.7 shows that SPF Ltd has been controlling costs that it has direct control over fairly well. The biggest increase in costs over the last 10 years has come from the cost of cans, which the company has to buy in from outside. The fruit costs increased due to greater tonnages being processed, although the price paid per ton has come down over the past few years. It is recognised that the pineapple industry, internationally is becoming more competitive and this has shown in the reduced financial performance of SPF Ltd over recent years (Duncan, 2006). As such it has become necessary to consider areas where savings may be realised, while potentially simultaneously achieving indirect benefits.

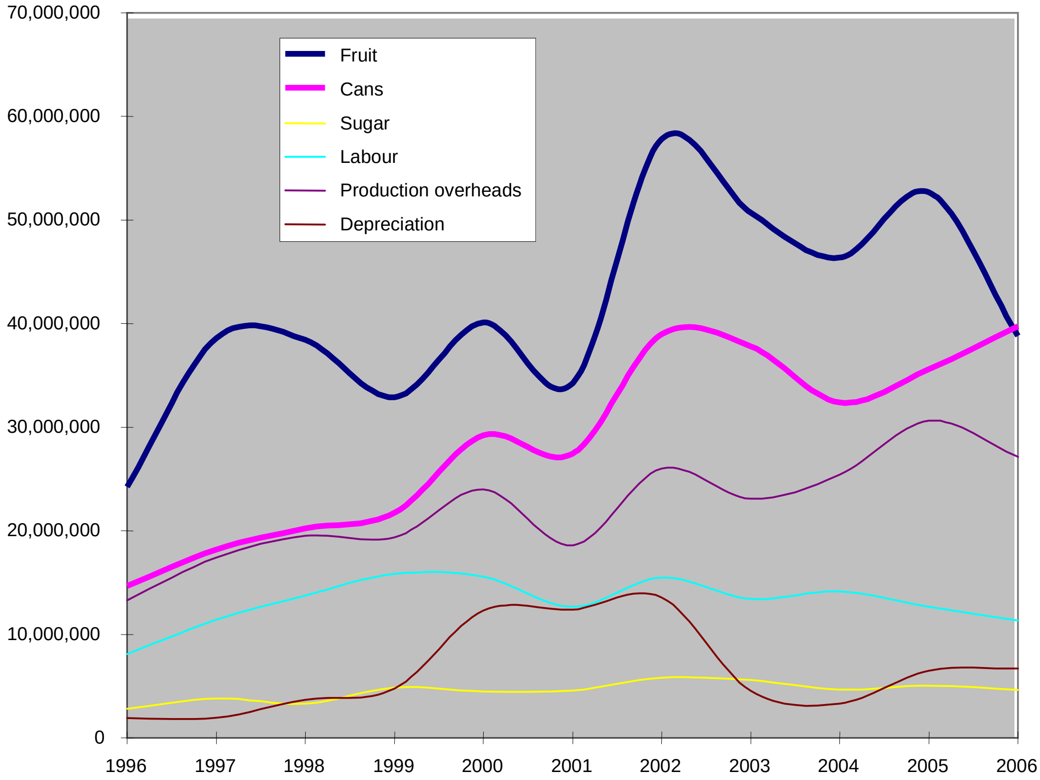

Figure 2.7 SPF Ltd cost of sales 1996-2006 (Source: Duncan, 2006).

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research questions

Based on the outcome of the literature review (Chapter 2), the following research questions to be answered were:

i. What is the current environmental policy and related performance of SPF Ltd?
ii. Does the understanding of environmental performance provide insights for improved efficiency?
iii. How should the above influence the development strategy of the business?
iv. What indicators would be applicable for the ongoing monitoring of environmental performance within the industry?

The research methods used to address the above are described below.

3.2 Case Study Research and Research Paradigm

The research was carried out in the form of a case study within the context of qualitative research with a positivist orientation. The case study method is an intensive investigation of a single unit (Handel, 1991 in Babbie and Mouton, 2004). *"A case study is a study of a bounded 'system,' emphasising the unity and wholeness of that system, but confining attention to those aspects that are relevant to the research problem at the time"* (Stake, 1994:258). In this research, the boundaries were the physical boundaries of Summerpride Foods Ltd, situated in East London and any activities within the plant that could have significant impacts on the environment.

One of the main objectives of qualitative methods of research, such as the case study, is to identify the relationships of realities and so gather and collate an understanding of the meanings of what has been found, rather than attempting to verify a predetermined hypothesis (Perry, and Coote, 1994). This, it could arguably be said, means that case studies draw attention to the question of what specifically can be learned from the single case being researched. It could further be said that the focus, design and form of each case study are strongly influenced by the researcher's disciplinary framework and research interest (Stake, 1998: 256). Based on this, it could then be said that a case study involves the process of learning about the case in question as well as the product of what is learnt from the case study. It could also be argued that what is

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research questions

Based on the outcome of the literature review (Chapter 2), the following research questions to be answered were:

i. What is the current environmental policy and related performance of SPF Ltd?
ii. Does the understanding of environmental performance provide insights for improved efficiency?
iii. How should the above influence the development strategy of the business?
iv. What indicators would be applicable for the ongoing monitoring of environmental performance within the industry?

The research methods used to address the above are described below.

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It is recognised that qualitative research is grounded in the assumption that features of the social environment are constructed as interpretations by individuals and that these interpretations tend to be transitory and situational (Gall, *et al.* 1996). This indicates that qualitative researchers study things in their natural settings and from their findings, make interpretations. As the research is conducted in natural settings, the researcher is the primary instrument for the data collection and analysis, rather than from an inventory, questionnaire or computer analysis. Guba and Lincoln (1981), state that the human researcher is characterised by *"the ability to consider the total context, adapt techniques to the circumstances, process data immediately, clarify and summarize as the study evolves, and explore anomalous responses."*

Maxwell (1998) enumerated five research purposes for which qualitative studies are particularly useful, of which some are characteristic of this study, namely:

- Understanding the processes by which events and actions take place.
- Understanding the particular context within which the participants act, and the influence this context has on their actions.
- Identifying unanticipated phenomena and influences, and generating new, grounded theories about them.

In conducting the research for a case study, it is important that any observations made and interviews done or information gathered from other people should be assimilated without bias. This could lead to new information being revealed which means the researcher needs to be readily adaptable and flexible to accommodate unanticipated events and to change data collection methods if necessary. As such the researcher needs to understand what issues are being studied, so that data is not merely recorded, but is also interpreted and acted upon accordingly. For this to be totally effective, the researcher should lack bias in the subject study.

Babbie and Mouton (2004: 645), define positivism as *"a metatheory that is based on the key assumption, that the social sciences should follow the lead of natural sciences and model its own practices on that of the successful natural sciences."* In the context of this case, which deals with environmental issues, one could argue that this implies that any activity, which impacts on the environment at SPF Ltd, should be identified and steps developed and implemented to minimise the negative effects on the environment. Yin's (1994) case study model in a positivist mode emulates features from natural science on the basis that the more measurable and objective the criteria, the greater the confidence in the results. Of importance here is the researcher's ability to recognise and assimilate a variety on information gathered from the diverse data collection techniques and to use each type to obtain the best result.

It is generally accepted that a case study is appropriate when one is interested in detailed information specific to a particular case, such as the current one involving SPF Ltd. It is also appropriate when one wishes to describe and understand complexities that are generally not susceptible to quantification, such as by way of a survey for example. What is required though are decisions within the case concerning places to visit, events or operations to observe and persons to interview. The objective of the researcher is to seek out what is common and what is particular about the case, with the end result presenting something that is unique to the study.

In this case study, it is more of an intrinsic type study, when the goal was to gain a better understanding of the current environmental performance at SPF Ltd and how could this information be used to develop a long-term integrated environmental and development strategy for the company. Hammersley, (1992), states that the purpose of an intrinsic case study, *"is not theory building, but to come to a better understanding of the case."* Robson (1993) refers to this type of case study as 'exploratory', which he views as being the most common. This is because the researcher seeks actual facts about the current situation as well as new insights, asking questions where relevant with the goal being to assess the study in a new light.

3.3 Project scope

The research was carried out within the factory premises of SPF Ltd, East London, which is one link in the total lifecycle of pineapple production in South Africa. This is illustrated in Figure 3.1 which shows the basic lifecycle of pineapples that are grown for processing. Within the premises of the organisation, the various sections where different operations, directly relating to the processing of pineapples occur were identified. These, for the purposes of this research were then numbered in the same way as factory personnel refer to them in the performance of their daily tasks. These sections are referred to as operational units for the purposes of this research.

The Merriam-Webster (2006) dictionary, defines operational as: *"of or relating to, or based on operations."* The same dictionary also gives one of its definitions of a section as: *"a part that may be, is, or is viewed as separated."*

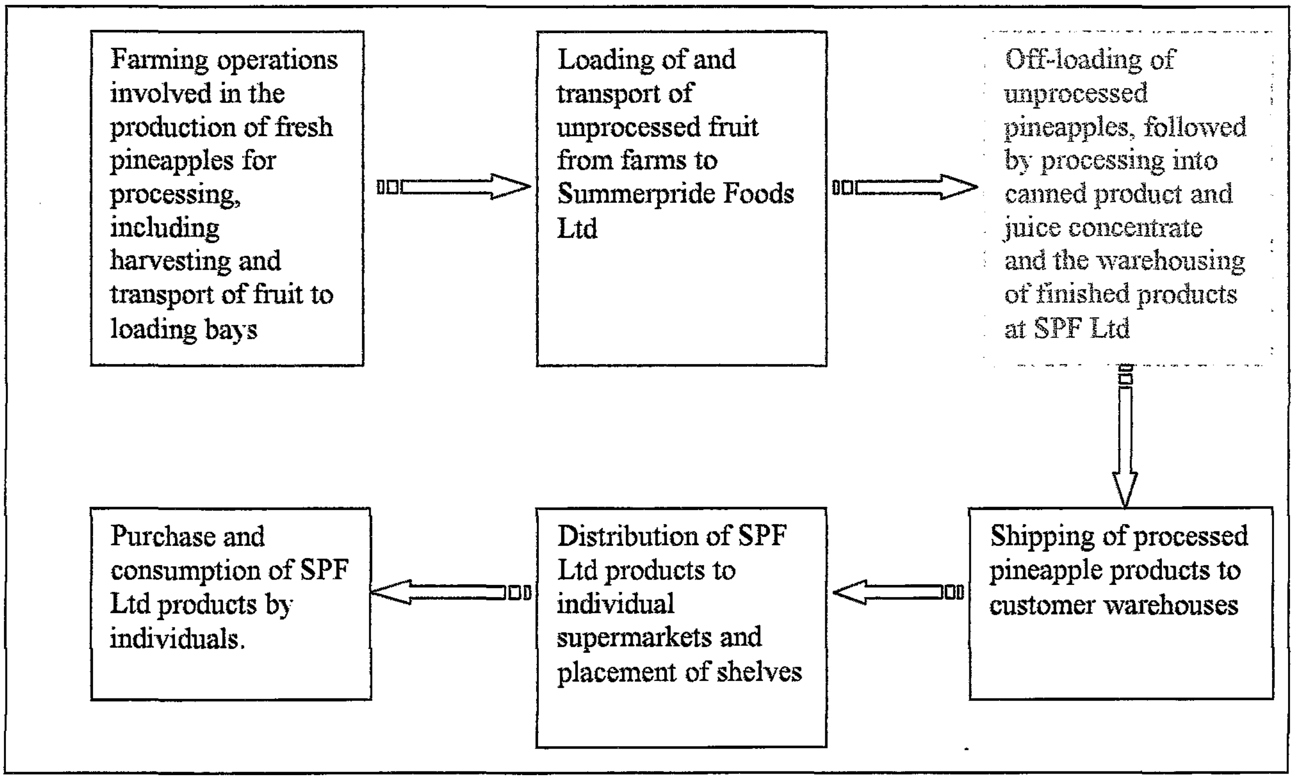

Figure 3.1 Basic steps in the lifecycle of pineapples grown for processing, highlighting the boundaries of this research

Within the boundaries of the research which was limited to the actual processing of pineapples (Figure 3.1), it was necessary to compare findings based on a comparable functional unit. In this project, an appropriate functional unit was considered to be a "ton of pineapple processed". The

Merriam-Webster (2006) dictionary, defines functional as: 1: *"of, connected with, or being a function"* and 2: *"designed or developed chiefly from the point of view of use."* The functional unit used for the purposes of this research is "per ton of pineapple processed."

Once the boundaries of the scope this research had been set, it was necessary to gather data and information relevant to the research.

3.4 Data collection

3.4.1 Review of SPF Ltd records

In this case study, the researcher made a number of visits to SPF Ltd, spending time in all sections of the organisation, had leading discussions with various members of staff. Quantitative data was collected from records available in the different sections of the factory. These included reports that are distributed to management as well as those distributed to various departments within the factory such as production and engineering. Water and coal usage records were obtained for the period of production from February to the end of September 2006 (Figures 5.1, 5.2, 5.4 and 5.5). Records of the cost of sales (Figure 2.7) were for the years 1996 – 2006. Quantitative data was obtained from either the relevant departmental manager or departmental superintendents or clerks. This information was gathered during a number of visits made by the researcher to the factory during the performing of his normal work as well as a few visits made specifically to undertake this research. Relevant archival data was also gathered.

3.4.2 Semi-structured interviews

Whilst gathering quantitative information, the researcher initiated discussion about the topic and asked questions with regard to the information being collected. No formal interviews were undertaken with the specific aim of having the discussions take place in a relaxed and informal manner with the hope that some information that the researcher might need would be volunteered by the other party. General, unstructured interviews were conducted with five members of senior management, an engineering superintendent and three clerks from the administrative, engineering and stores departments.

Once the quantitative information had been gathered and the discussions completed, informal notes were made by the researcher for later reference. Time was spent on a number of visits by the researcher studying all operations within the various departments at SPF Ltd, so that it was possible to draw up process descriptions and identify all resource usages per department. Based on the life-cycle analysis approach the researcher then conducted an input: output analysis of these processes. From this analysis, the direct costs of the resources used was investigated and an analysis conducted of which resource that should be prioritised for further investigation with the goal of improving efficiencies.

3.5 Data analysis and interpretation

3.5.1 Task scope

Having set the boundaries of this research as being the operations that are involved in the processing of pineapples within the premises of SPF Ltd, situated in Burgersdorp Rd, East London, it was possible to set the scope of this task. A conventional input-output analysis was employed to determine key interactions of the pineapple processing operation with the environment. The list of inputs/outputs identified were then fed into a utility index ranking system to calculate a score in order to be able to prioritise which inputs/outputs to target for possible improvement measures to be implemented.

3.5.2 Utility Index Ranking

The fact that it was likely to identify so many different aspects to have possible intervention for improvement measures to be implemented, it was necessary to develop a ranking system to prioritise where to start.

Three measures were used to compile a ranking system: As the study's goal was to highlight areas of resource inputs that should be prioritised for possible efficiency improvements, an estimated value of recovery/improvement in monetary terms was used (Box 1). For this to happen, the researcher had to obtain the direct monetary costs of the inputs and outputs. The figures used in SPF Ltd budget (2006) for were used for this exercise.

A number of mitigating measures may be employed to reduce the probability of resource wastage and these were ranked according to the probability and cost (Box 2). The last factor used was a ranking of the resource use according to national priorities, as per the State of Environment Report 2005. A scale of 1 to 3 was used in an effort to avoid the subjectivity of the exercise (Box 3).

Box 1: Estimated monetary value of recovery/improvement (Rands)	
Score	**Value range**
1	< 50 000
2	50 000 – 100 000
3	100 000 – 200 000
4	200 000 – 400 000
5	> 400 000

Box 2: Mitigation measures	
Score	**Description**
1	No effective mitigation possible/unlikely due to costs involved
2	Effective mitigation possible but difficult to ensure effectiveness and will be expensive to maintain
3	Effective mitigation in place and will be relatively effective on most occasions
4	Effective mitigation in place and is always likely to be effective
5	Minor process change needed at relatively low cost with effective training

Box 3: National priority ranking	
Score	**Ranking**
1	Low
2	Medium
3	High

The final ranking score was obtained by multiplying the three individual measure ranks per input-output identified in the input output analysis (Figures 4.3 and 4.4) e.g. a hypothetical possible score would be 3 x 4 x 2 = 24. A maximum score of 75 was thus possible.

3.5.3 Validity and reliability

There is no uniformly accepted set of validity and reliability criteria for case studies. Validity can be interpreted as referring to the accuracy and value of the interpretations made, whilst reliability is often taken to be the extent to which other researchers would arrive at the same or similar results if they studied the same case using exactly the same procedures. According to Yin (1994), when data from three sources e.g. observations, interviews and archival records coincides (triangulates), then a robust fact may be considered to have been established.

Four criteria have been identified in a positivist design in regard of validity and reliability. These are:

- Construct validity – the extent to which a measure operationalises the concepts being studied;
- Internal validity – the extent to which the researcher has demonstrated a casual relationship between two factors by showing that other plausible factors could not explain the relationship;
- External validity – the extent to which the findings can be generalised; and
- Reliability – the extent to which other researchers would arrive at the same conclusions if they studied the case in exactly the same way

(Yin, 1994).

3.6 Ethical considerations

Case studies are dependant on the sensitivity and integrity of the researcher, who is the primary data gathering instrument. In this case study, the researcher is a member of the senior management team and therefore has an interest in accurate findings. This has been made easier by the fact that the results of this study will only be presented to the rest of the SPF Ltd management team and Board of Directors for consideration as a proposal when complete. The author is aware of having some personal bias in regard to this subject and is of the opinion that international customer requirements will make the study worthwhile and enable the organisation to react in a strategic manner to retain and obtain market share.

3.7 Limitations of the research

The fact that it is often difficult to generalise the findings of a case study research project is often cited as a limitation of this research approach. Linked to this, is a concern that case studies can either oversimplify or exaggerate a situation, leading the reader to make a wrong conclusion about the actual state of affairs, as distinct from the report itself (Guba and Lincoln, 1981). However, skilful data collection, analysis and reporting can reduce the potential for this happening.

The researcher should be skilled in both observation and interviewing. Since interviews are mostly semi-structured, it is important that the researcher make the people being interviewed feel as though they are in a relaxed environment and can speak freely without having to worry about any ulterior motives that may have a negative impact on them. The aim of the interview is to encourage the free flow of information, which could lead to some totally new or unexpected data or facts being found.

3.8 Process flow of this research

The scope of this research was limited to the processing of pineapples after they had been delivered to SPF Ltd in East London. The data used include historical performance figures for the past 10 years and on a weekly basis for the period January to the end of September 2006. The goal of this research was to identify all 'environmental inputs" (e.g. energy, water, chemicals etc) and all 'environmental outs' (e.g. effluent, solid waste, air emissions etc) and then rank them (based on the scoring system given), to prioritise for further investigation into measures that could be implemented to increase either efficiency of use or to reduce their impact on the environment. Figure 3.1 gives the processes that were followed in compiling the findings of the study.

The top two ranked items were then further investigated and weekly usage figures of their consumption during the period February to the end of September 2006, obtained from administrative staff. Further on-site investigations were done to ensure the researcher had a clear understanding of their use and also to identify any opportunities for improvement. This allowed for a detailed resource-use analysis to be conducted. Where the researcher was unclear about certain procedures pertaining to their use, clarity was obtained from the departmental manager which also lead to the discovery of some procedures that hadn't seen on prior visits. From this the researcher was able to formulate proposals that should be considered as part of the overall strategy of the business

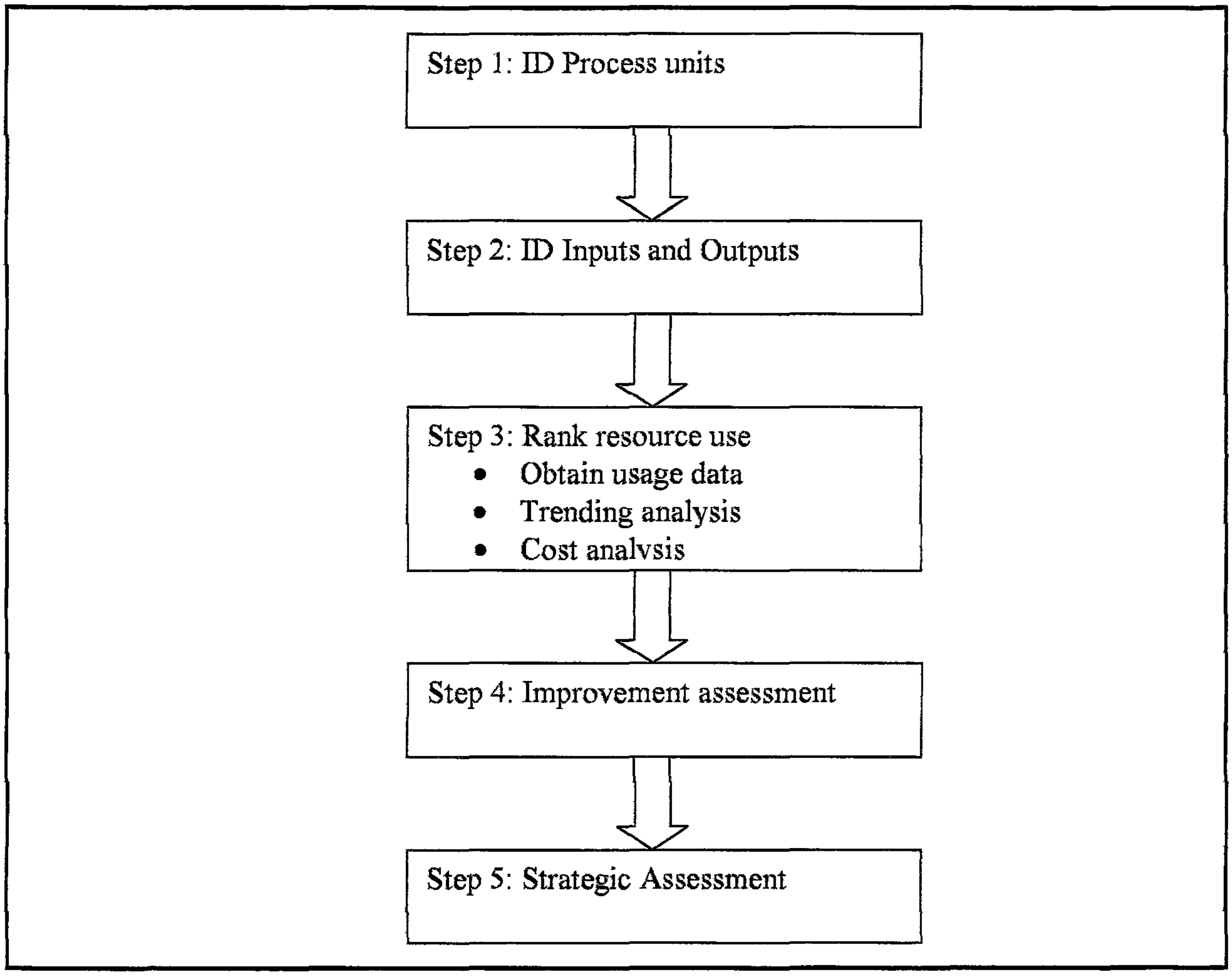

Figure 3.2 Process followed in compiling findings of study

3.9 Conclusion

As a methodology, the case study research method is well established and accepted and is responsive to what, why and how questions. The best result is generally obtained when the researcher can accept ambiguity and is responsive to emerging data, which may result in refining the design of the study as it progresses. A case study is extremely useful for exploratory research and is particularly appropriate for applied research related to the contempory issues of people in the real world. It was therefore an appropriate method to investigate the potential for improved environmental performance within SPF Ltd.

CHAPTER 4: INVENTORY ANALYSIS

4.1 Introduction

As this research was only concerned with the processing of pineapple and the identification of inputs and outputs that were of environmental concern, the description only includes the actual processing and the secondary processes. The life cycle stages of resources and outputs before they arrive on the factory premises and after they leave them were not taken into account. The operations involved in the administration and human resources departments were ignored as they were regarded as having a relatively low impact with regard to resource utilization.

4.2 Breakdown of operations into operational units

Figure 4.1 gives a simplified process flow diagram of fruit through the factory. The operational units have been labelled 01, 02, 03 etc. in accordance with references use by factory personnel. A detailed description in the context of the intrinsic case study methodology of research which is to come to a better understanding of the case (Robson, 1993), is given below.

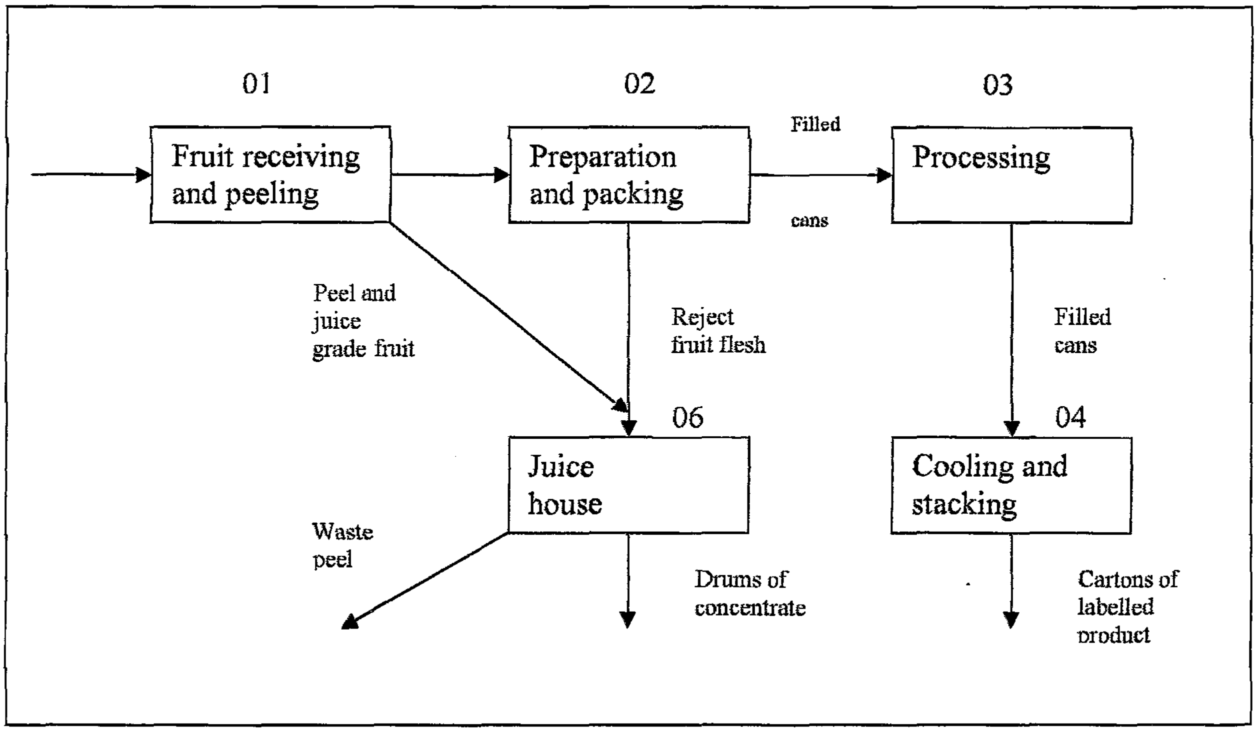

Figure 4.1 Process flows of fruit through operational units at SPF Ltd

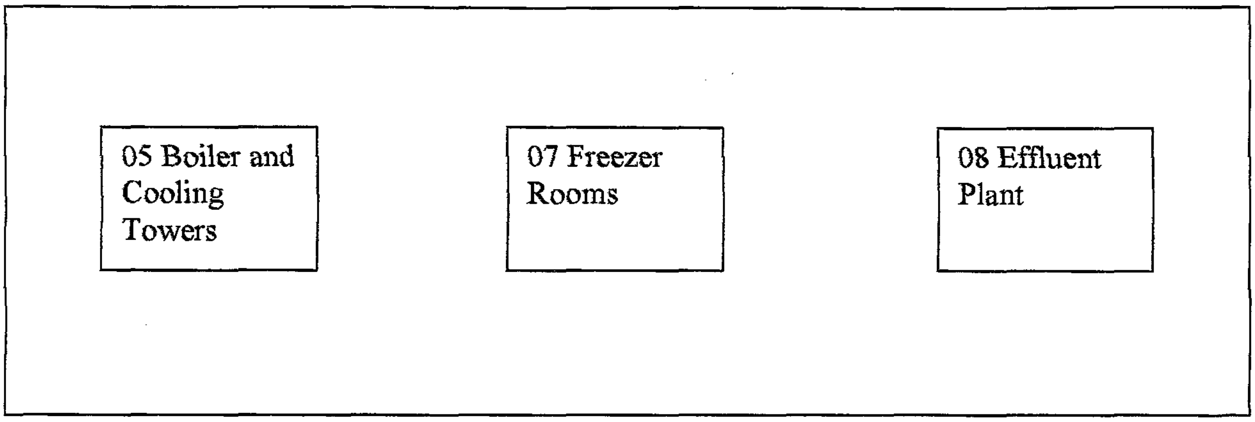

Figure 4.2 Auxiliary Service Operational Units at SPF Ltd

The flow of fruit through the factory as well as the sites of the operational units, relative to each other is shown in Appendix C which is a map of the factory.

4.2.1 Fruit receiving and peeling

Pineapples, for processing are delivered to the factory by road transport. The trucks delivering the fruit are weighed at arrival and on departure, so that the weight of fruit delivered can be calculated. Once inside the factory premises, the bins holding the fruit are off-loaded under a gantry (01 in Appendix C), which has two separate cranes operating independently of each other. This enable the one crane to off-load the trucks, whilst the other places bins onto a cradle rocker system that then tips the bin and throws the fruit into a dumper bath. The crane that feeds the dumper bath also places empty bins on the trucks to take back to the loading bays in the farming areas.

Once the fruit is in the dumper bath, it is propelled by means of a water jet towards a conveyor belt that takes the fruit to a screw grader, where the fruit is sorted into three sizes for processing purposes(01 in Appendix C) , namely juice grade and No.3 size fruit; No.2 size fruit and No.1 size fruit. From the size grader, the fruit is fed onto three merry-go-rounds that can accumulate approximately three tons of fruit, whilst it is waiting to be processed through the peeling machines. The fruit is fed off the merry-go-rounds, into peeling machines (ginacas, so called after their inventor), which are set to peel 72 pineapples per minute. There are thirteen ginacas, with four dedicated to peeling No.1 size fruit, six to peeling No.2 size fruit and one to peeling No.3 size fruit. Each ginaca has a dedicated operator to ensure that they operate smoothly. Each pineapple fed into them has its top and tail cut off, is peeled and the core of the fruit removed as well. The peel, core and tops and tails, fall onto a conveyor belt where they are taken to the juice processing area to be processed into "B" grade juice and juice concentrate. All waste peel and other product that has not been recovered during the processing procedure is removed from the factory via a conveyor belt from the juice house (06 in Appendix C).

4.2.2 Fruit preparation and packing

From fruit receiving and peeling, the fruit passes down through stainless steel tubes onto conveyor belt lines into the preparation and packing section (02 in Appendix C). In this section, workers, on as many as thirteen lines, trim the fruit of any peel that was not removed by the peeling machines. The fruit then passes through electrically operated slicing machines. From here the fruit is further examined by workers and any slice with a blemish or that is broken is placed in either a runway that will take it for processing into pieces, or on one that will take it for processing as Grade 'A' juice and juice concentrate. Slices that are deemed to be of suitable quality are then place in cans of various sizes, depending on the planned production for the day. Pieces of suitable quality are placed in cans for piece production or go onto a conveyor belt to the first line where it goes through another machine that mills it into "crush." The "crush" is then packed into the required can size. Any fruit flesh that is left at the end of this process ends up on a conveyor belt which takes it to the juice plant for processing. All empty cans are fed into this part of the factory by means of conveyor belts. This section's floors are constantly being washed down and all equipment is given a thorough washing with food safe disinfectants between shifts (Eldridge, 2006).

There are thirteen lines and the can sizes packed at SPF Ltd are A10; A2.5; A2; A1 Flat and A1 Squat. The can size used on any one day is dependant on what the factory has been instructed to pack by the sales department (Lentz, 2006). Empty cans are stored in an adjacent warehouse and are fed by conveyors to the preparation and packing section. Cans in the empty can warehouse are stored on wooden pallets which are moved around by forklift until de-palletised by workers who feed them onto the conveyor belts taking them to the preparation and packing. Empty cans are ordered on a monthly basis, according to projected fruit flows and sales requirements. Any cans not used are carried over until needed in the next couple of months of production.

Once the cans are filled with pineapple flesh (slices, pieces or crush), they then pass under liquid fillers, called can 'syrupers', where natural, pineapple juice or syrup made from white sugar and water is added. Due to this being a food factory, by-laws with regard to hygiene and insect control have to be adhered to, so this section is well sealed from outside contamination.

4.2.3 Processing department

From the preparation and packing section, the filled cans are carried by conveyor belts to the processing department (03 in Appendix C). Here the filled cans pass through what are called exhaust boxes, which preheat the fruit and juice, and then have their lids fitted at electrically operated machines, called seamers. There are a number of operators covering this section to ensure the operation runs smoothly. Once the lids are fitted, the cans are carried by conveyor belt to the cookers. The factory has two types of cookers, namely atmospheric, where a combination of hot water and steam maintain a temperature of 98°C, and pressure cookers where a constant flow of steam maintains a temperature of 105°C. The largest and smallest can sizes (A10 and A1 Flat), are cooked in the atmospheric cookers and all other can sizes in the pressure cookers. The cans pass through these cookers by means of a reel and spiral system that is constantly revolving and are pasteurised in the process. The cans then pass through a cooling tunnel where cold water is sprayed on the cans as they pass through via another reel and spindle driven system.

As the filled cans arrive in this department without lids, strict hygiene regulations have to be followed to prevent outside contamination of the product. This means that this section is well sealed off from the outside. Despite having a substantial air conditioning facility operating here, this area of the factory remains very hot, due to the heat from the exhaust boxes and cookers. From here the cans are carried by conveyors to a section known as "cooling and stacking" (04 in Appendix C).

4.2.4 Cooling, stacking and warehouses

Once the fully processed pineapple in cans arrives in this area (04 in Appendix C), they are collected and packed onto pallets depending on their can size and product code. The pallets of cans are then stacked in what are termed cooling bays where in accordance with the law, they have to be quarantined for a minimum of 10 days before they can be labelled and shipped (Eldridge, 2006). In this form of storage, product is referred to as 'bright stack' and remains this way until orders are called off. Once an order to ship has been received, the product is then moved on wooden pallets by a gas operated forklift to the labelling lines, where the correct labels are glued on and the product packed onto cardboard cartons which are then stacked on export quality pallets for storage until "stuffing' of containers in which the finished product is shipped takes place. All canned product is labelled with the buyers own brand labels, which are manufactured by various South African firms. These firms allow for a four percent over-run on the amount ordered, but only charge for the amount ordered. The benefit of using the buyer's labels is that the 'marketing' of the product ends at this stage and SPF Ltd doesn't have to spend large amounts on advertising in all forms. All pallets are moved by forklifts, of which the SPF Ltd has eleven and all are gas powered.

Export pallets have to have been fumigated with methyl bromide in accordance with regulations. Currently SPF Ltd has around 1000 of these pallets fumigated each month, on site at the factory by an external contractor (Bobbins, 2006). When a batch of 'export' pallets arrives at the factory, this company is called in to do the fumigation. During the fumigation process, the pallets are stacked in an area away from the factory (Appendix B – between the boundary fence and No.40), covered with plastic and the methyl bromide is then pumped in. The covered pallets are left for 24 hours. There is no designated permanent area for this task as it takes place during normal working hours and at times SPF Ltd leases parking space to Daimler Chrysler for new vehicles. Pallets are ordered as required and any excess are carried over until needed. Product destined for sale on the local market is shipped on "hired" pallets (Chep pallets) which are hired as needed. The onus of their return is on the buyer of the product, as the rental for their usage is transferred to the buyer.

A record is kept of the type, amount and age of product in the warehouse, so that product is not kept in there for too long and thus reaches its expiry date. The entire canned product produced has a shelf life of two years. Some product volumes have to be built up over time due to the volume required by certain customers. Product destined for sale on the South African market is moved by forklift to a separate warehouse (Part of 04 in Appendix C), where there is also a factory shop. The empty cans and 210L drums, in which juice concentrate is packed arrives by road transport, packed on wooden pallets which are then off loaded using forklifts. They are then stored in the warehouses close to the processing area (04 in Appendix C).

Product that is being shipped is labelled, then 'stuffed' into shipping containers with the aid of forklifts. Once full, the containers are taken by road to either the East London or Port Elizabeth ports for shipping to international markets. The choice of harbour is dependant on the shipping line and target point of the product.

4.2.5 Juice plant and evaporators

Presently, juice is considered a by-product of the canning operation as around 70% of the fruit received is aimed at the canning lines. All of the peels, tails and toppings from the peeling machines, as well as flesh material rejected for solid pack in the fruit preparation and packing section are taken by conveyors to the juice section (06 in Appendix C). Here it passes through a number of presses and screens to extract as much fresh juice as possible and to separate the remaining solids which are then regarded as waste material and is taken by conveyor to the waste hopper behind the gantry as discussed under the fruit receiving and peeling section. Fruit that is consigned specifically for juice can bypass the peelers and go straight into a machine known as a Kelly Cutter, which mangles it. It is then taken by screw conveyor to the presses in the juice plant. There are two sections in the juice plant each with their own presses, screens, bulk juice holding tanks (decanters), heat exchangers which aid the separation of raw juice from any solids as well as for pasteurisation of the juice. The two sections are necessary as the factory manufactures both 'A' and 'B' grade juice concentrates.

The juice is stored in the decanters until there is sufficient volume to keep the evaporators, which concentrate the juice, running at a consistent rate as well as to ensure that batches of concentrate have the same brix (a measure of sweetness) levels and brix: acid ratios. The juice is kept cool in theses tanks by the use of glycol which is circulated between the two outer layers of the tanks. The juice is pumped to the evaporators along a stainless steel pipeline for concentrating. The area is constantly being washed down for hygiene purposes and a water meter in this section is used to record water consumption.

The evaporator section is some way from the juice plant as it has had to be expanded as the tonnage processed has increased over the years. It is divided into two sections as both concentrate that needs to be frozen as well as aseptic concentrate is made. Heat is required to warm the raw juice to a temperature where it is concentrated. The temperature required varies according to the amount of solids (pulp) being left in production. Low pulp concentrate needs a temperature of 72°C, whilst high pulp concentrate needs a temperature of 95°C before it is concentrated (Lentz, 2006). Before being drummed off into plastic bags inside 210L drums, it is cooled down in tanks that are insulated with a glycol flow around them. Both the A and B grade concentrate drums are then placed in the freezer rooms to cool down more rapidly.

When raw juice is concentrated, around six times as much liquid is evaporated than is recovered as concentrate. This evaporated liquid is collected as condensate and is pumped into two storage tanks situated behind the evaporator plant. This condensate is used to wash the belt presses, the decanters and the floor of the juice plant. However, more condensate is collected than is used for the above purposes and the balance is drained into the effluent system.

4.3 Auxiliary or Secondary Processes

4.3.1 Boiler and cooling towers

The factory has two boilers, one coal fired and the other oil burning but has only used the coal fired boiler, which has a bigger capacity (18 tons of steam per hour), for the past ten years. The oil fired boiler, due to its lower capacity and higher maintenance costs when operational, has been neglected for a number of years (Bobbins, 2006). Steam is required for the cookers inside the processing department as well as for the evaporators in the juice processing areas, where raw juice is concentrated. Currently SPF Ltd uses around 6000 tons of coal per annum (De Lange, 2006).

Pineapple production in peak season requires up to eleven shifts (2 per day, Mon – Friday and Saturday day). The concentrating of juice takes longer and will often run into Sunday if production takes place on a Saturday. This requires the boiler to be operational. Coal is fed in by means of an automatic feeder onto a screw conveyor feeding the furnace and needs to be of either grain or pea size (max average diameter < 25mm) for it to burn at optimum efficiency and thus heat. The ash is collected in an area behind the boiler and is sold to a brick maker (De Lange, 2006). Any coal used with a larger diameter does not burn fully during its passage through the furnace section and is still burning when dumped onto the ash pile. When this occurs, it necessitates the setting up of an irrigation system to douse this burning coal, leading to increased water consumption and more coal consumed to obtain the required amount of steam. The water used in the boiler is softened with chemicals before it is fed into the boiler. These chemicals demineralise, degas and ensure that the pH of the water is at the correct level. This water is also pre-heated before entering the boiler by a combination of steam condensate and steam injection once the boiler is running, to obtain maximum efficiency (Bobbins, 2006). The water that is heated and used in the atmospheric cookers, as well as the steam condensate and hot water used in the juice house is cooled in five cooling towers which are situated behind the processing department, the juice concentrator section and one close to the boiler.

4.3.2 Freezer room and blast freezer

Concentrate is stored in two freezer rooms until it is shipped (Refer to 07 in Appendix C). Aseptic concentrate is also stored in theses rooms until the space is needed for frozen concentrate, as it prolongs its shelf-life (Eldridge, 2006). Like canned product, all concentrate has to go through a two week incubation period before it can be shipped to the markets. Frozen concentrate must be at -18°C before it is allowed to be shipped. This sometimes requires that it is placed inside the blast freezer to obtain this temperature. Each of the freezer rooms and the blast freezer has three compressors in use to obtain and maintain the required temperature. Drums of concentrate are moved in and out of these rooms on wooden pallets by forklift.

4.3.3 Effluent treatment

Due to the constant washing down, all sections produce effluent. This effluent is collected in various sump tanks and pumped to an effluent pond where solids are removed. The effluent is then aerated and the pH adjusted to meet Buffalo Municipal regulations (between 7 &10), then pumped into the municipal effluent collection system. Sewage from the factory joins the municipal effluent system separately (Appendix D – Effluent Flow). There are full time operators looking after this section, ensuring that the correct amount of lime or caustic soda is added in order that the pH of the effluent is correct prior to discharge. There is nothing further done to this effluent in terms of reducing chemical oxygen demand, conductivity, oils, greases and degreasing agents etc. The amount of effluent discharged into the municipal system is recorded by taking readings at a meter situated at this station.

4.3.4 Solid waste collection and disposal

Other general waste, such as pineapple plant leaves, metal off cuts, spare part packaging etc. is placed in rocker bins which are moved to collection points on a regular basis. This waste is then collected by a waste tip truck and carted away to the municipal dump. Damaged cans are collected and taken to a designated waste disposal area, where they are compacted and sent for recycling. There is no written procedure for this operation and the site is not clearly demarcated as being as the can recycling collection point.

4.3.5 Chemicals used for hygiene and cleaning

SPF Ltd out-sources this operation, using Süd-Chemie and their staff to supply and add the chemicals used for hygiene and what is termed cleaning-in-process (CIP), in the juice section of the factory. The chemicals used are stored within a separate lock-up storeroom with the central storeroom of the factory (Bobbins, 2005). An inspection of this room revealed that there was no lip in the door way that could retain any spillage inside. There was no material available inside the store to deal with spillages. All but one of the chemicals stored inside the room were stored in plastic bins. Ventilation in the room is very poor and there was a strong smell of chemicals inside the room. Süd-Chemie are contracted to do the CIP and their personnel are responsible for drawing the chemicals when and as needed and for ensuring that they are used correctly. General cleaning inside the factory is the responsibility of SPF Ltd and is done during working hours, mainly by hosing down spillages etc. Hygiene maintenance cleaning is done in the processing sections when no production is taking place, between shifts.

4.3.6 Quality assurance and laboratory

This department continually monitors production to ensure that all products produced are within regulated specifications (Eldridge, 2006). Parts of the tests undertaken involve bacterial and yeast counts on daily production samples. Once completed, the samples are collected and stored in a container provided by Waste-tech, who collect and replace these when full. As some syringes and needles are also used here to collect juice and concentrate samples, Waste-tech provide a 'Sharps' container for the collection and storage of these.

4.4 Resource input/output analysis for all operational units within SPF Ltd, involved in processing and including secondary processes

Based on the initial inventory analysis which is a necessary step of LCA (Brown, 1998., Duda and Shaw, 1995., and Portney, 1994), it was possible to identify all of the inputs and outputs (Figures 4.3 and 4.4) of the processing steps and auxiliary operations. In terms of the scope and goal of the study which is concerned with environmental efficiencies on SPF Ltd premises, only those items identified during the inventory analysis were considered.

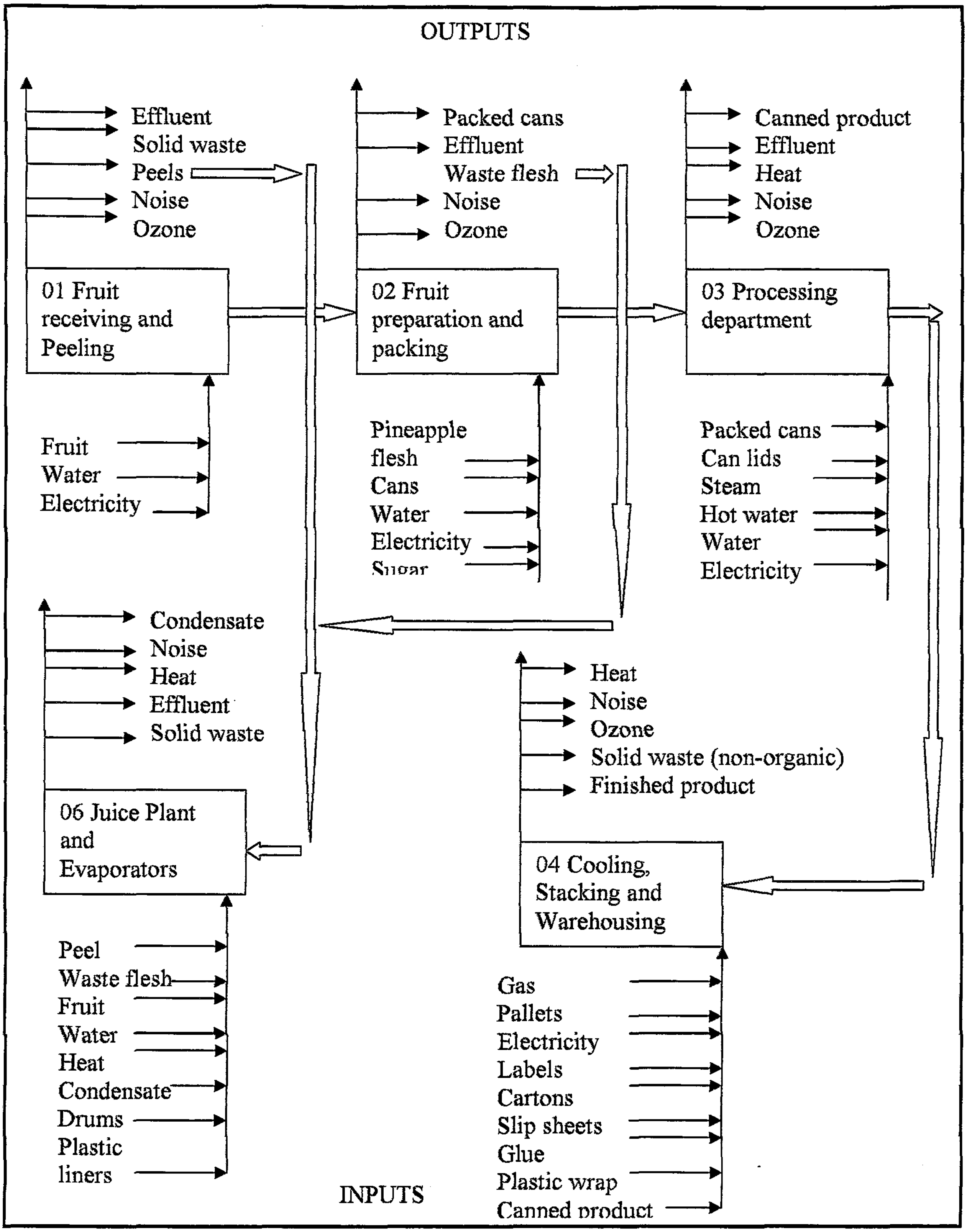

Figure 4.3 Input Output analysis of pineapple processing at SPF Ltd

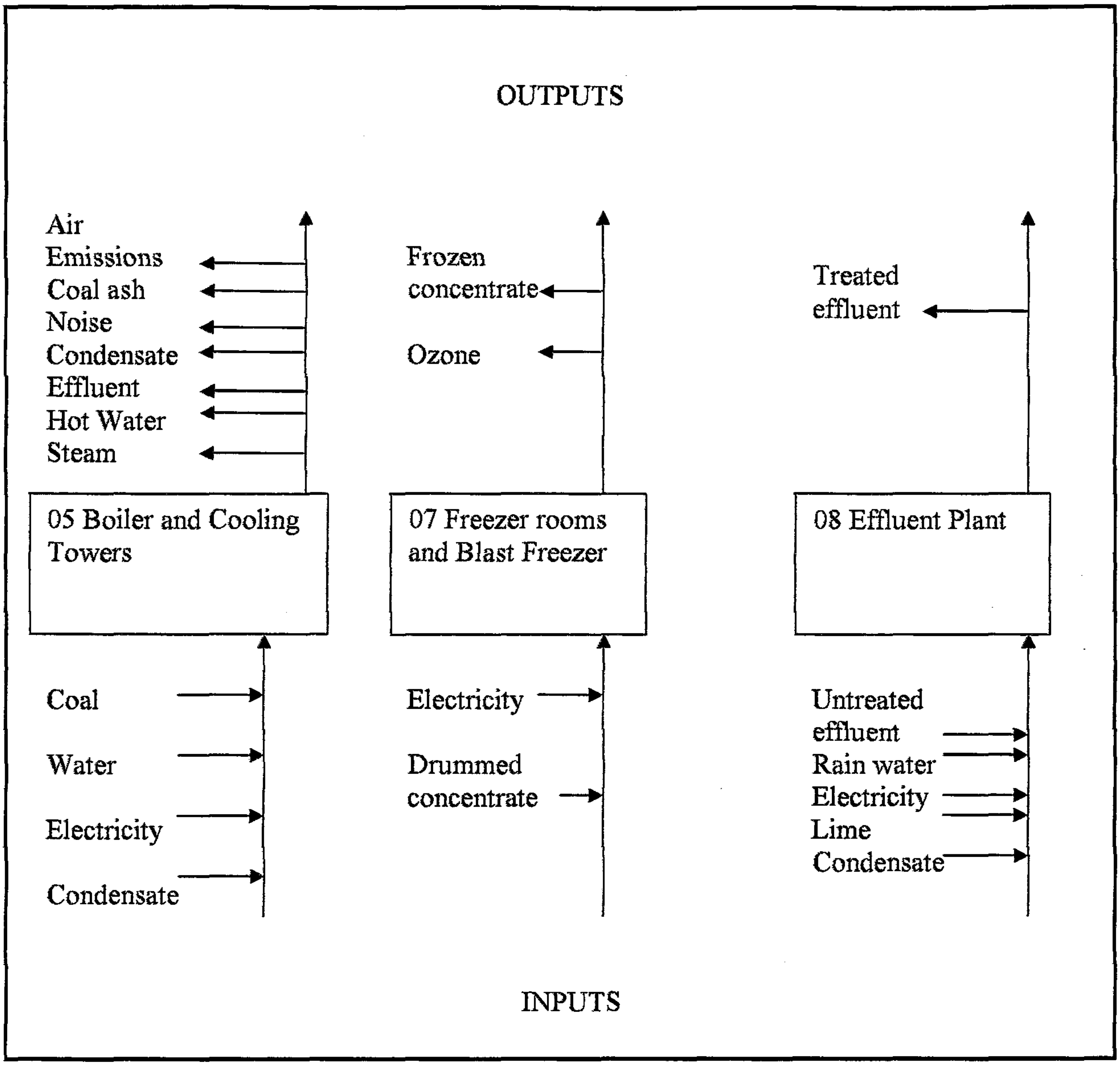

Figure 4.4 Input Output analysis of auxiliary processes involved in pineapple processing at SPF Ltd

From Figures 4.3 and 4.4 it can be seen that the solid inputs identified are: pineapple; sugar; cans; concentrate drums; labels; cardboard cartons; other packaging materials; wooden pallets; lime and cleaning chemicals. These result in outputs of flesh for canning, raw pineapple juice, organic waste, syrup and waste syrup, canned pineapple, damaged cans, free of charge (FOC) cans, drummed concentrate, labelled canned product, solid wastes, packed canned product as well as noise, methyl bromide emissions and untreated and treated effluent. Liquid inputs are water and raw pineapple juice and the resultant outputs are syrup, effluent, steam, hot water, pineapple juice concentrate and condensates (steam and from concentrating raw juice). Electricity is used to power much of the equipment used throughout the factory. The description of the process of fruit through the factory (4.2.1 – 4.2.5) explains how these inputs are used in the factory.

Table 4.1 Resources used and waste produced during processing and direct costs involved

RESOURCE	**DIRECT COST TO SPF Ltd (Rand)/ANNUM**
1. Electricity	R 1 720 000-00
2. Water	R 1 650 000-00
3. Effluent (lime to balance pH)	R 558 000-00
4. Coal	R 3 100 000-00
5.Waste Peel	(R 84 000-00) – sold to dairy farmers
6.Tin Cans	R 34 786 871-00
7. Concentrate drums	R 4 962 389-00
8. Sugar	R 4 635 626-00
9. Labels	R 3 231 344-00
10. Cartons	R 3 444 558-00
11. Packaging material (slip sheets, cling wrap, ink dyes, glues etc.)	R 1 356 084-00
12. Solid waste removal	R 165 000-00
13. Coal Ash	(R 98 000-00) – sold to brick manufacturer
14.Wooden Pallets (1 000 warehouse and 14 000 export market)	R 776 000-00
15. Condensate from juice evaporators	Nil
16. Boiler operating emissions	Nil
17. Cleaning chemicals (Süd Chemie contract)	R757 812-00
18. Noise from daily operations	Unknown (staff issued with protective clothing)
19. Lime	R 75 000-00

(Direct costs obtained from SPF Ltd Budget Summary, 2006).

There are three sources of energy inputs used in the factory, namely coal; electricity and gas. The gas is used to power the forklifts, while coal is used in the boiler and electricity is used throughout the factory. The use of these resources results in outputs of air emissions, noise, coal ash, heat and ozone. Having identified what resources that are used during processing as well as waste produced, the direct cost of these to SPF Ltd were investigated (Table 4.1) in order to ascertain the possible value of potential savings that could be made, which was used as part of the scoring system to determine where attention should be focused to formulate measures to increase efficiencies in accordance with the methodology given to rank opportunities of possible resource efficiency improvement.

Using this information as well as the results obtained in the input/output analysis and in conjunction with the utility index ranking scoring method described in the methodology section, a ranking of both the inputs and outputs was obtained. The results of which are shown in Tables 4.2 and 4.3.

Table 4.2 Score results of inputs for ranking purposes

Summerpride Foods Ltd. EMS audit – September 2006				
Input	**Potential saving Score (S)**	**Mitigation score(M)**	**National priority ranking (P)**	**Total S x M x P**
Pineapple	1	1	1	1
Sugar	4	2	1	8
Cans	3	2	1	6
Drums	1	1	1	1
Labels	2	3	1	6
Cartons	2	3	1	6
Packaging material	1	3	1	3
Wooden pallets	3	3	1	9
Chemicals	1	4	1	4
Lime	1	4	1	4
Water	4	5	3	60
Raw juice	1	1	1	1
Coal	4	3	2	24
Electricity	2	3	3	18
Gas	1	4	2	8

Table 4.3 Score results of outputs for ranking purposes

Summerpride Foods Ltd. EMS audit – September 2006				
Output	**Potential saving Score (S)**	**Mitigation score (M)**	**National priority ranking (P)**	**Total S x M x P**
Flesh	1	1	1	1
Raw Juice	1	1	1	1
Organic waste	2	4	1	8
Syrup	4	1	1	4
Waste syrup	1	2	1	2
Canned pineapple	4	3	1	12
Damaged cans	3	3	1	9
FOC cans	1	1	1	1
Noise	1	3	1	3
Drummed concentrate	1	3	1	3
Solid waste	1	3	2	6
Methyl bromide	1	2	3	6
Effluent	1	3	2	6
Chemicals	1	2	3	6
Steam	1	2	1	2
Hot water	1	2	1	2
Air emissions	1	1	3	3
Condensate	2	3	1	6
Ozone	1	1	3	3
Noise	1	1	2	2

From the Table 4.2, one can see that water and coal usage ranked the highest on the input rankings. Despite cans having the highest input cost (Table 4.1), they scored lower on the potential savings side due to the cannery giving this area of operations close attention during production. There also was not sufficient information available to separate those cans that are actually damaged during the production process and those that are termed FOC (Free of charge) and are opened for quality testing purposes or that are kept as samples of production in case of claims by a customer. Samples of each day's production and of each customer's orders are kept until either inspected in the case of a customer claim or until their expiry date is reached, which is three years after the production date (Bobbins, 2006). This is an area that should be investigated in the long-term and actual damaged cans and FOC product recorded separately. Resources, such as cans, labels, pallets, sugar, labels and packaging material can and are carried over in stock for use at a later date if excess of any of these resources results.

In the output rankings (Table 4.3), canned pineapple ranked highest but was ignored for the purposes of this exercise as it results in income for SPF Ltd. Damaged cans ranked second but due to the reasons given above were also ignored. They should however be properly investigated in the future to ascertain their true cost to SPF Ltd, which may result in further investigation to determine ways of reducing both the cost to the cannery and increased efficiencies of use. Organic waste, being waste peels and flesh ranked third and was also ignored in this exercise as they are sold to dairy farmers in the East London area as a food source (Bobbins, 2006). In the long-term this could be further investigated to ensure that SPF Ltd is obtaining maximum value from this form of waste.

4.5 Conclusion

From the Tables 4.2 and 4.3, it can be seen that the highest ranking scores obtained were on water and coal usage. Being the highest ranked, the use of these two resources was further investigated on a weekly basis for the period from the start of production in February 2006 until the end of the SPF Ltd financial month of September 2006. This was done by obtaining records of their use for this period.

CHAPTER 5: IMPROVEMENT ASSESSMENT

In identifying water and coal (an energy source) as the two items that should be investigated for improvement, SPF Ltd is in a similar position to many other food and beverage processors where the similar concerns have been identified. The Australian FBI industry reports a water consumption of 3L/kg of products for food in general. Internationally FBI processors are looking at improving energy use in their operations (CIAA, 2002). *"Water shortages and climate changes will be the biggest environmental challenges in the 21st century* (Yadav, 1999).

5.1 Water

Freshwater is essential to support human life, ecosystems, and economic development, yet the long-term sustainability of water is in doubt in many regions of the world. Thus both water quantity and water quality are becoming dominant issues in many countries. Problems relate to poor water allocation and pricing, inefficient use, and the lack of adequate integrated management. Major water quality problems stem from sewage pollution, the intensive agricultural use of fertilizers and pesticides, industrial wastes, saltwater intrusion and soil erosion (UN, 2006 on-line). In the food-processing industries, water is mostly use as an ingredient, but also as an initial and intermediate cleaning source, an efficient transportation conveyor of raw material, and a principle agent used in sanitising plant machinery and areas. Currently, in this industry, water is a prime target for pollution prevention and source reduction practices (Deconinck *et al.*, 2006). Reports show a reduction of 28 percent in water consumption, mainly through recycling, in the Food and Beverage industry since 1990 (CIAA, 2002). These reports provide no information about how these savings were attained.

5.1.1 Consumption analysis

Archival records obtained from SPF Ltd show that in 2003 water consumption was 2.9Kl per ton of fruit processed, in 2004 it was 2.8Ll per ton processed and in 2005 it was 3.0Kl per ton processed. However these figures did not show the weekly variance in water consumption and it was for this reason that the weekly consumption was analysed in this study. The range of water consumption per ton of fruit processed goes from the best of 2.2Kl/ton in the week ending 20/08/2006 to 5.6Kl in the week ending 19/02/2006 (Figure 5.1). There were mitigating factors for the high water usage in this week as well as the week ending 7/05/2006. The next highest weekly consumption per ton of fruit processed was 3.5Kl/ton during the week ending 5/03/2006.

The information given in Figure 5.1 clearly shows the enormous variations in the amount of water consumed per ton of fruit processed at SPF Ltd in the period from the start of processing in February to the end of September 2006. In the first half of this period, water consumption was, with the exception of the weeks ending the 12th and 19th of March, as well as the first four weeks of April, higher than the average of 2.7Kl/ton of fruit processed. The factory processed 31 176 tons in the first 17 weeks (19/2/2006-11/6/2006) of production, (average of 1834 tons per week), when the water consumption was consistently above the average for the whole period measured (Figure 5.1). In the balance of the period measured (16 weeks: 18/6/2006-1/10/2006), the factory processed another 45 219 tons of fruit (average of 2826 tons per week), when water consumption per ton of fruit processed dropped below the average for the whole period (SPF, 2006). The reason for this swing in production is due to growers achieving a higher yield per hectare at this time of the year, so they target the bulk of their production for this period (Scott, 2006). The standard deviation on water consumption in this period from the week ending 19th February until the end of the week ending 11th June 2006 was 918L/ton of fruit processed against 745L/ton for the whole period measured and 196L/ton for the period of the week ending 18th June until the end of September 2006 (Figure 5.1). The average of 2.7Kl/ton of fruit processed was only consistently bettered once the factory was working close to 3000 tons of fruit per weekly.

The extremely high consumption that occurred in the first week of production, (5.6 Kl/ton processed), was the result of the cannery doing a 'dry' test run (without processing fruit) to check all valves, pumps, steam pressure and machinery etc. before production commenced (Lentz, 2006). Consumption then followed a similar trend to the total amount of tons processed for a while before a peak towards the end of April and early May. The peak occurred over the period when there are a number of public holidays which disrupted production. The extremely high peak, when 5Kl of water was consumed per ton of fruit processed, in the first week of May (Figure 5.1) was as a result of a tap(s) left running over the public holiday on the 1st May by an artisan or his co-worker who had been doing maintenance work in overtime then. This indicates that there is a lack of systems in place and that training with regard to educating employees about the need for eco-efficiency needs to take place. Another factor that contributed to the high water use in the first half of the period measured and analysed was that the factory did not man all its canning processing lines until the first week in April, processing fruit mainly for juice concentrate until

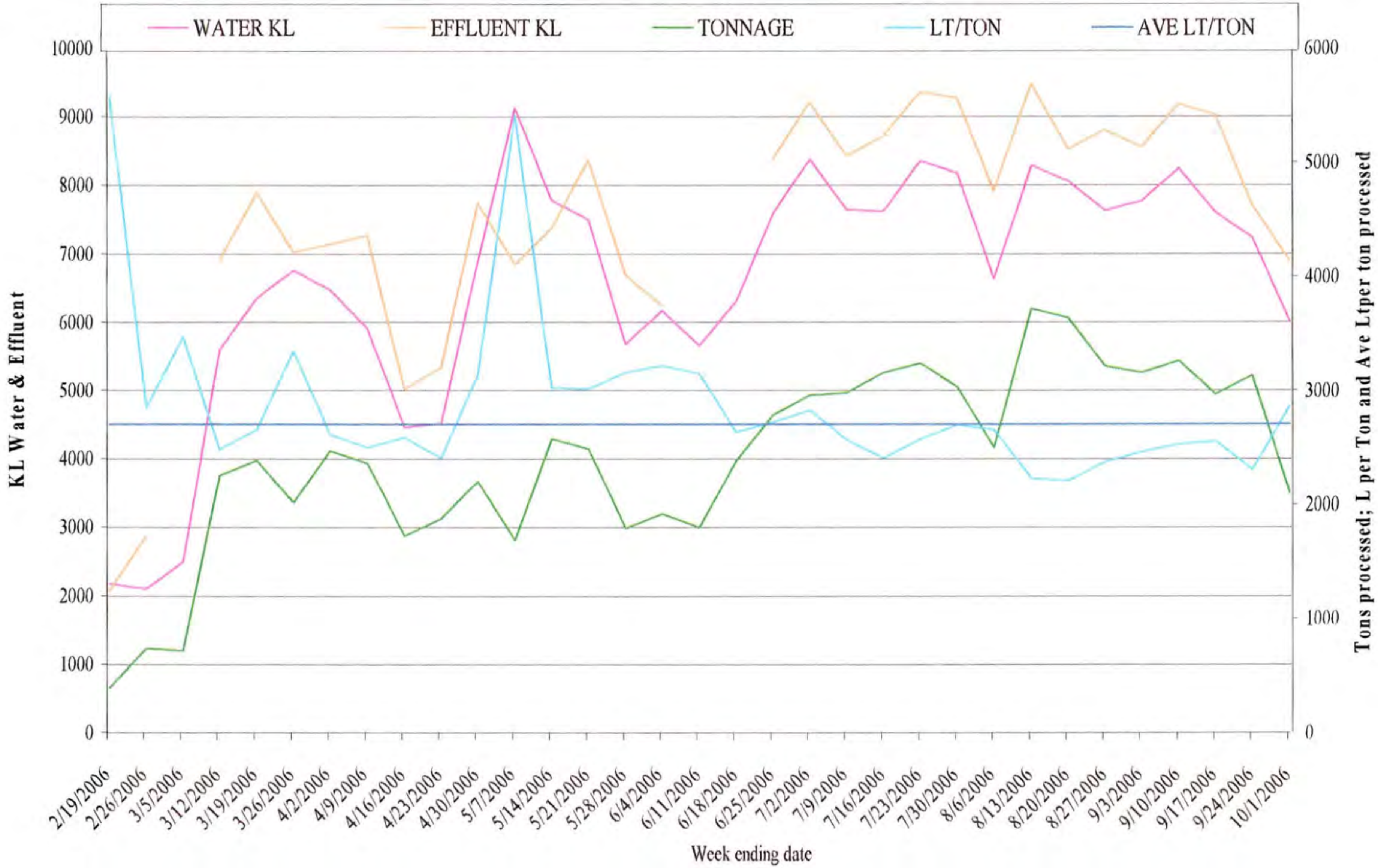

Figure 5.1 Water consumption records vs tons pineapples processed at SPF Ltd 19/02/2006 - 01/10/2006

then. Only six out of the 12 canning lines were operated during this period. This meant that steam had to be supplied to the required areas, although they were not at full production. In the period measured for the study, the amount of water used to produce steam was 40 024Kl out of a total municipal consumption of 204 488Kl. This translates into 19.6% of the total water consumption for this period.

Effluent discharged follows a similar pattern to the water consumed (Figure 5.1). The volumes of effluent discharged exceeded water consumed for the majority of the sample period as a result of condensation from the process of making juice concentrate. Approximately 6L of condensate is released into the effluent system for every 1L of concentrate produced (Bobbins, 2006).The drop in discharge when the factory had a peak at the start of May (Figure 5.1) was due to the effluent treatment and discharge unit not working on the public holiday during that week and as the water wasted due to a tap being left open, the water did not require much treatment to comply with municipal regulations, so was left to accumulate before discharge. This showed up in the following two weeks discharge. The missing information with regard to effluent discharge is due to no records available from the engineering clerk responsible for measuring and recording it (Mcapayi, 2006).

From the above analysis of water usage during 2006, the key factors affecting water usage were:

1. water wastage due to carelessness and lack of awareness
2. tons of fruit processed on a weekly basis
3. lack of recycling of water and condensate
4. lack of suitable equipment

5.1.2 Improvement assessment

In considering possible improvements, those falling under the heading of structural and operational, were largely related to cleaner production opportunities, whilst those under management and training were closely linked to the development of environmental management plans (EMPs). The main areas of potential reduction being considered by the entire food-processing industry are water used in conveying materials, plant cleanup, or other non-ingredient uses (Deconinck *et al.*, 2006). With regard to SPF Ltd, the areas that apply to it are in the plant cleanup or other non-ingredient uses. The changes required fall into three categories, specifically, structural, operational and management and training.

5.1.2.1 Structural changes

- The fitting of automatic cut-off valves to all hose pipes should be implemented. This would prevent wastage of water by taps being left open. It is hard to quantify exactly how much this would save but as the records showed, there is 80% of the total usage available (accepting that there is not much that can be improved on in the boiler operation) for possible improvement measures.
- In areas where water is used to wash down machinery or other areas of the plant (water broom), then the hoses should have nozzles fitted that create a higher pressure flow but use less water.
- Recycling of condensate: The ICC (1998) advocated recycling as one way of reducing resource usage, increasing efficiencies and generally become more eco-efficient. Although not quantified, some condensate produced at SPF Ltd is recycled for use in the juice plant to clean the belt presses, the floor and to breakdown sludge that has collected in the juice decanters. There is no holding tank for this condensate, so the excess flows to the effluent pond. This condensate is suitable for use in the fruit receiving and peeling section of the factory (Bobbins, 2006). The juice plant is situated next to the fruit receiving and peeling section of the factory (01 and 06 on Figure 4.4), so all it would entail, is the installation of a pipe that would carry this condensate from the juice plant to the fruit receiving and peeling section of the factory.
- Recycling of waste water: this needs to be further investigated as the quality of the effluent at the treatment plant (Figure 4.4: 08) is unknown. The factory is cleaned between shifts with hygiene chemicals and there is also degreasing agents from when machinery is cleaned in this effluent.

5.1.2.2 Operational changes

- Based on the trend analysis of the water consumption (Figure 5.2) one could argue that the factory needs to run at close to full capacity throughout all production to achieve a lower consumption per ton of fruit processed. The average consumption in the second half of the period measured was 2.5Kl/ton of fruit processed. This would entail spreading the crop out evenly over the year. Currently most of the fruit is produced in the second half of the year (Figure 5.1), due to growers obtaining higher yields then. It is standard practice to induce flower initiation on lands of pineapple plants for management purposes. Pineapples are also planted throughout the year, although the majority are planted in the July to September period. By getting growers to plant more in the period October to March, more lands could have flower initiation induced to produce fruit in the first half of the year (Scott, 2006). This would help reduce the amount of water consumed per ton of fruit processed at the factory is more fully utilised. To achieve this in as short a period as possible, the use of fruit price incentives could be implemented i.e. SPF Ltd would pay more for fruit delivered in this period than for fruit in the second half of the year. Figure 5.2 shows how water consumption per ton of fruit processed drops as the amount of fruit processed weekly increases. This indicates that there should be a concerted drive to spread the tonnage throughout the year as Figure 5.2 shows that processing 3000 tons or more per week resulted in the best water usage efficiency in the period measured.
- The setting of a water consumption target could help change the approach to water usage in SPF Ltd. Taking the average consumption of 2.7kl water per ton or fruit processed (Figure5.1) and using the lowest figure recorded, 1.4kl per ton processed in one day (SPF Ltd, 2006: 4 July), a target of 2.0Kl, per ton of fruit processed should be set. The fact that during the second half of the period measured, when water consumption was around 2.5kl per ton (Figure 5.1), indicates that savings are possible whether by increased daily productivity or by reduced usage. Taking into account that the boiler uses nearly 20% of the total water usage, this means that a saving of 32% in water usage needs to be found elsewhere in the factory. Figure 5.2 shows that a usage of 2.2Kl water per ton of fruit processed was attained in August 2006 with no improvement measures implemented, which indicates that the setting of a target of 2.0Kl/ton of fruit processed is not unreasonable.

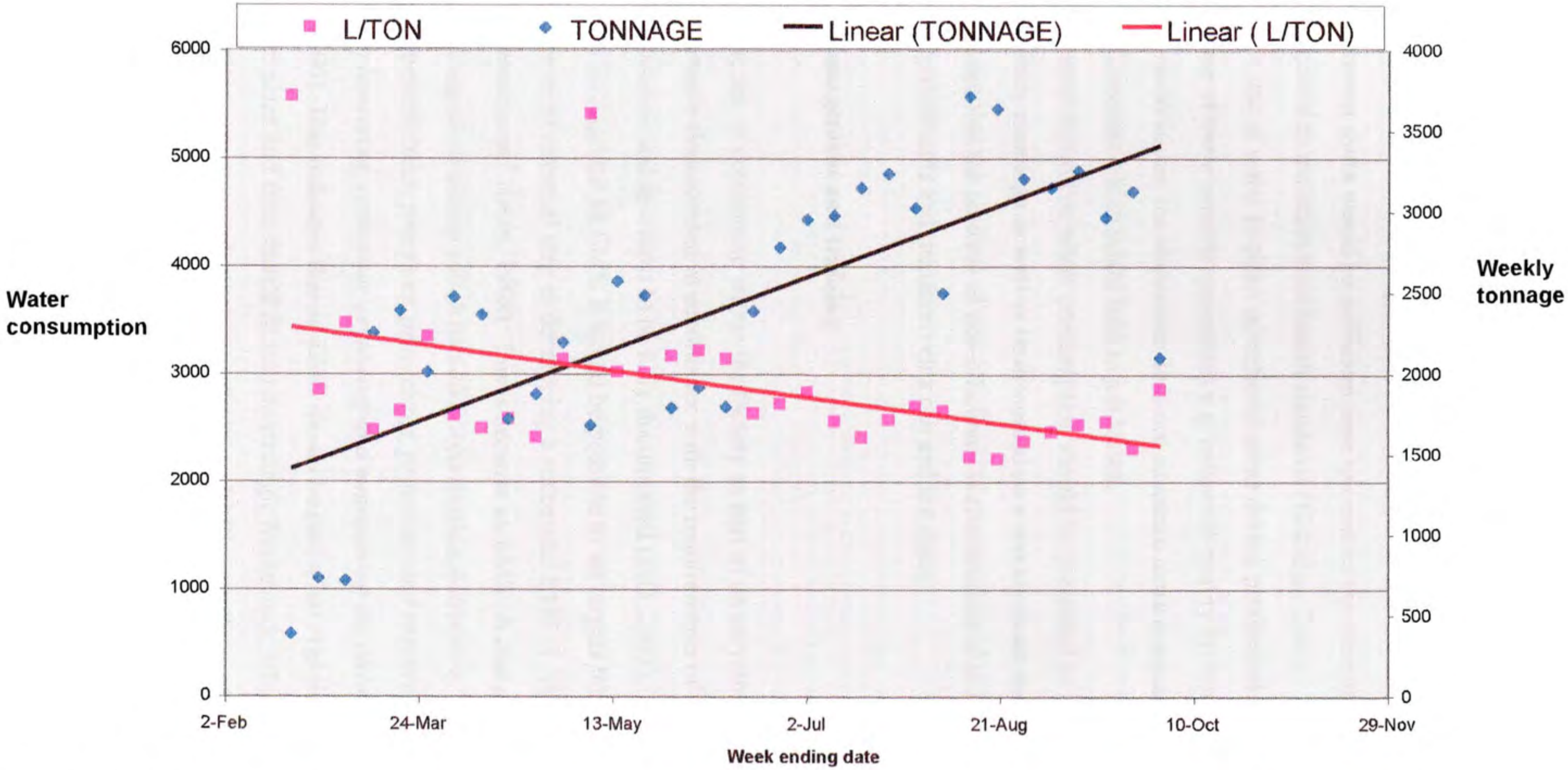

Figure 5.2 Trend analysis of tons pineapple processed vs L of water used per ton pineapple processed at SPF Ltd 19/02/06 – 01/10/06

- Currently the factory works two eight and a half hour shifts per day with a three and a half hour break between them. Consideration should be given to working factory continuously for 17 hours per day, then doing the hygiene cleaning at the end of this period, once a day instead of the twice a day that is current practice. This may result in further unintended efficiencies elsewhere e.g. with coal consumption in the boiler. The seven hour break between shifts would be sufficient time to conduct the necessary hygiene cleaning required to maintain food health standards (Eldridge, 2006).
- The use of water to clean operational areas during production should be reduced by the issue of more suitable equipment e.g. industrial quality brooms. Due to social considerations, the researcher does not advocate more automation to achieve improved efficiencies which could lead to job losses.
- Formal reports on water consumption should be presented to management during their bi-weekly meetings as well as be discussed on a weekly basis during production meeting to ensure that the concept of eco-efficiency is communicated to all employees where improvements and measurements can and are made.

5.1.2.3 Management and training

- The use of condensate within the factory as part of its recycling program should be formally documented in accordance with the requirements of an EMS which requires processes and measures to be fully documented (ISO, 2005).
- By linking into an EMS, it would be possible to set targets for energy consumption.
- The most essential step in developing a successful EMS is *"obtaining top management commitment"* (DOE, 1998). This is because an EMS "*is that part of the overall management system which includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy"* (ISO, 1996). This indicates that an EMS should be part of an organisation's management policy and plans and thus should fit into its strategic framework, which implies that management needs to have an understanding of why an EMS is needed and of what the benefits of having such a system in place are. Once this happens, the implementation of structural and operational improvements suggested will be easier to implement due to management buy-in of this concept. This can only be achieved if the right information is collected,

disseminated and discussed during management operational meetings. Top management can then communicate its support through an organisational policy that clearly states a commitment to:

- Compliance with laws and applicable requirements;
- Prevention of pollution;
- Continuous improvement;
- Other supporting goals of the organisation.

Based on the above considerations and following a request from the SPF Ltd Quality Manager, the researcher developed a draft environmental policy (Figure 5.3) and submitted it to SPF Ltd for their use when dealing with enquiries from concerned customers. This policy has not been formally adopted by SPF Ltd and is open for review by Management. This policy could also lay the foundation for subsequent EMS activities and should be communicated throughout the organisation and to the public/customers so that personnel and stakeholders are aware of management support. The EMS should also fit into other management "quality programs" and an organisation's Occupational, Health and Safety program. The best way to achieve total management "buy-in" is to identify the benefits of implementing an EMS (European Commission, 2006), as identified in the Literature review.

If one accepts the argument that management buy-in is crucial to an EMS, then it follows that it is equally important to be able to manage environmental knowledge within an organisation with some sort of system. An environmental knowledge management system will provide a means of aggregating collective environment intellect and knowledge into a framework that will enhance learning, collaboration and innovation. Implementing such a system will require a cultural change in that environmental knowledge must be shared, means that people must have the technology that allows them to do so.

SUMMERPRIDE FOODS LTD. – ENVIRONMENTAL POLICY

SPF Ltd recognises the critical link between a healthy environment and sustained economic growth and is thus committed protecting and enhancing the environment and keeping its ecological footprint as small as possible.

In order to achieve this, SPF Ltd will:

- Integrate environmental considerations into its business planning;
- Identify, assess and manage environmental risks associated with its operations and products, to reduce or eliminate the likelihood of adverse consequences;
- Comply with all applicable legal and regulatory requirements for the protection of our employees and communities in which it operates;
- Make reduction, reuse and recycling the guiding principles and means by which it will achieve its goals;
- Build relationships with other environmental stakeholders – including government, the scientific community, educational institutions, public interest groups and the general public – to promote the development and communication of innovative solutions to industry environmental problems;
- To the extent that proven technology will allow, eliminate or reduce harmful discharges, hazardous materials and waste;
- Establish assurance programs, including regular audits, to assess the success of its policy in meeting regulatory requirements, program goals and good practices;
- Provide regular communications to, and training for, employees to heighten awareness of, and pride in, environmental issues.

Figure 5.3 Proposed SPF Ltd Environmental policy

This is where management as a whole and the Human Resources Department in an organisation have a major role to play. This because Human Resource Management (HRM) is "*the process through which an optimal fit is achieved among employee, job organisation, and environment so that employees reach their desired level of satisfaction and performance and the organisation* *meets its goals"* (Hall and Goodale, 1986:6). Although a broad range of information technology tools is required is required to encompass the processes, content and information sharing between people in an environmental knowledge management system, a set of common system functions can be identified:

- Capturing and storing environmental information through its articulation and documentation
- Organising the information by categorising it for storage
- Searching and retrieving the information
- Sending the information and providing access to it
- Structuring and navigating the information received
- Sharing and collaborating with respect to the information
- Synthesising, profiling and personalising information to meet user preferences
- Reaching solutions or making recommendations based on analysis of the information
- Using the new information or knowledge by applying it to business activities for decision making and opportunity identification
- Integrating the environmental information with other business applications
- Maintaining the environmental knowledge base.

All of these functions should be ongoing, with feedback and verification mechanisms used for continual improvement. Specific activities for each of these areas can also be defined, once a scope of the processes, content, functionalities and overall system has been determined (Ford, 2000).

5.1.3 Conclusion: water consumption

By targeting water consumption and the recycling of condensate to use in place of fresh water, SPF Ltd will meet some of the demands of eco-efficiency as stated in the Literature review as given by the ICC (ICC, 1998). In terms of what indicators that should be used to measure this, SPF Ltd should use Kilolitres of water per ton of fruit processed (Kl/ton or m^3/ton). For annual consumption, this will be Kilolitres per annum or m^3 per annum. A starting point of what bench mark to use for water consumption would be the 2.7kl/ton of pineapple processed during the period measured. Any daily usage above this should be thoroughly investigated and measures implemented to prevent this problem from happening again. This would require management to regularly review progress in this regard to ensure that measures are formulated and implemented to achieve this. With regards to implementing any environmental management system, it has been stated that *"if you can't measure it, you can't manage it"* (Logie, 2006). One could go a step further and say, there is no point in measuring anything unless you are going to act upon it and that is precisely what SPF Ltd should be doing.

5.2 Coal

Natural systems throughout the world act as sinks and filters that absorb pollutants resulting from economic activities. In the case of South Africa, its natural and environmental assets provide the platform for its economic activity and social well-being (Blignaut and de Wit, 2004). Compared to other industries such as the pulp and paper industry, the food processing industries are not considered particularly energy-intensive and fossil fuel use is relatively low (Deconinck *et al.*, 2006). Coal is the most abundant fossil-fuel resource and potentially the most damaging (Ouellette, 1973). In terms of South Africa's total consumption, industry, including the FBI only consume 1.6 percent of the annual total, using the figures for 2000 (Blignaut and de Wit,2004). Yadav (1994) argued that climate change is one of the biggest environmental challenges that need to be addressed in the 21st century and in this regard, South Africa contribution to the global green house effect ranks among the top ten countries (Blignaut and de Wit,2004). Thus any contribution to reduce usage in SPF Ltd will not only benefit the company financially but also the environment as "the sum of the whole is greater than the sum of the individuals."

With regard to complying with legislation, SPF Ltd has a certificate issued under the Second Schedule of the Air Pollution Prevention Act (45 of 1965). Buffalo City Municipality currently bases its by-laws in this regard on this legislation and has only inspected the boiler at SPF Ltd once in the past two years (Bobbins, 2006).

Any coal fired unit's configuration and operating expense profile reflects the quality of the fuel it consumes. Aside from normal maintenance, most change today is motivated by environmental compliance requirements (Jones and Patefield, 2005). SPF Ltd is aware that the South African Government recently implemented the National Environment Management: Air Quality Act (39 of 2004), (NEM: AQA (39 OF 2004)) which places the responsibility of continuous emission monitoring (CEM) on industry, with the authorities responsible for conducting the ambient monitoring (de Lange, 2006).

5.2.1 Consumption analysis

Archival records show that the kilograms of coal used in processing of one ton of fruit was 63.6kg/ton in 2003, 60.2kg/ton in 2004, 62.6kg/ton in 2005 and 60.5kg/ton in the period form February to the end of September 2006. The consumption of coal for the period measured from the start of production in the week ending 19/02/2006 until the week ending 01/10/2006 is given in Figure 5.4. Coal usage closely follows the same trend as the total tonnage worked and the only significant variance of coal consumed per ton processed was in the period from the week ending 7 May 2006 until the week ending 18 June 2006 (Figure 5.4). Further investigation showed that this was due to a lack of availability of suitable size coal from SPF Ltd suppliers over this period. Coal with a diameter of greater than 45mm was supplied during this period. The larger amount of coal consumed per ton of fruit processed over this period equated to R5-17 per ton as a direct cost. Further costs were incurred as SPF Ltd had to douse the coal that was not fully burnt in the boiler when it came out onto the ash heap. Apart from the start-up period in February, when the small tonnages of fruit processed resulted in in-efficiencies (Figure 5.4), there was not much of a deviation from the average amount of coal consumed per ton of fruit processed. This is because the boiler is automated and able to supply steam on demand to the factory (de Lange, 2006). As steam is supplied on demand, this had a minor effect on water consumption at that time. There was a slight improvement in consumption when the factory is working close to full capacity (Figure 5.5) during the period measured and like with the water analysis, points to efficiencies of scale, implying that more fruit needs to be processed in the first half of the period measured. In this regard, further investigation should be undertaken to see if this pattern is typical of all years or if it was only for the period measured for this study.

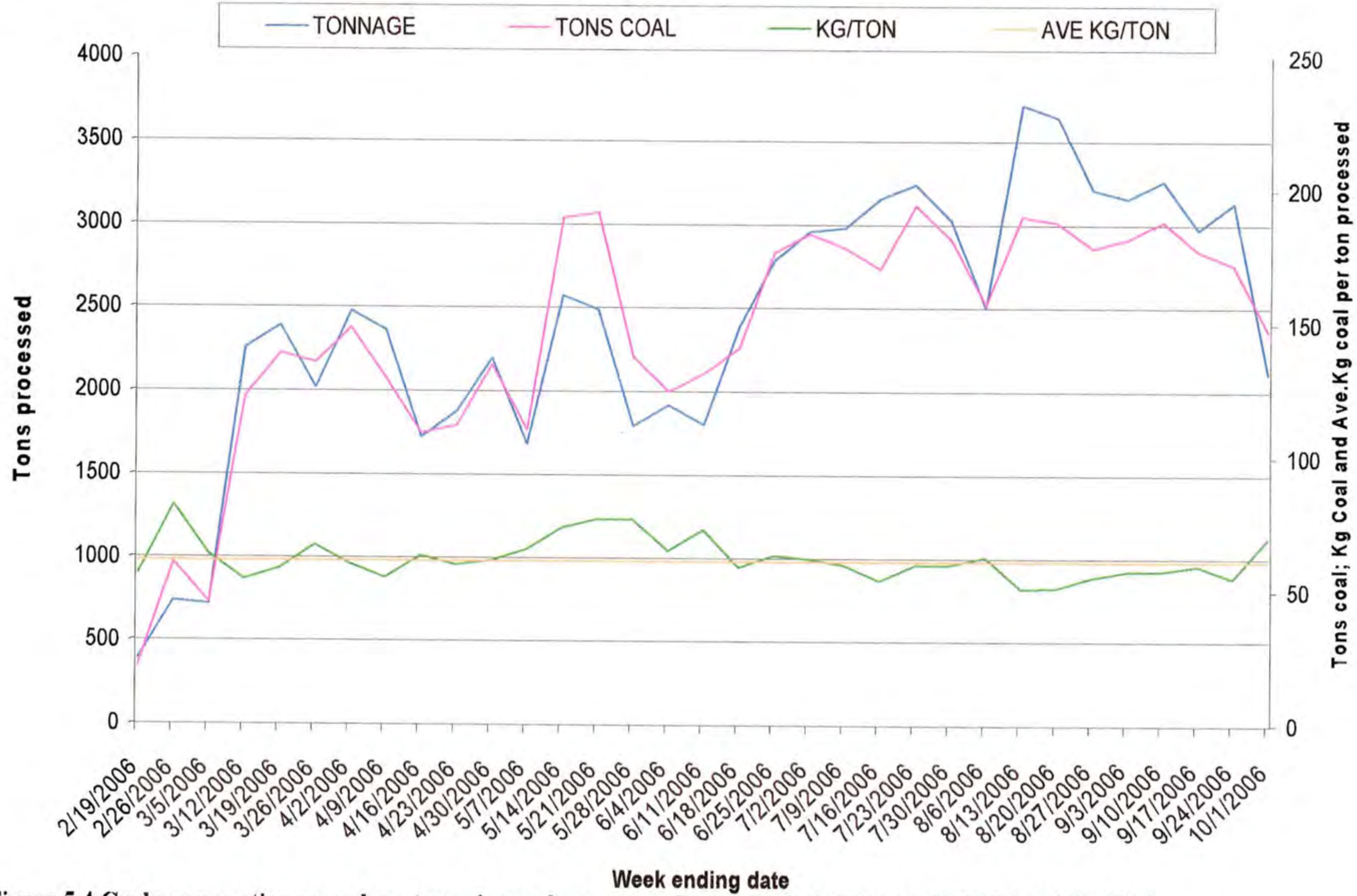

Figure 5.4 Coal consumption records vs tons pineapples processed processed at SPF Ltd, 19/02/06 - 01/10/2006

5.2.2 Improvement assessment

As with water, in considering possible improvements, those falling under the heading of structural and operational, were largely related to cleaner production opportunities, whilst those under management and training were closely linked to the development of environmental management plans (EMPs).

5.2.2.1 Structural changes

- No structural changes are recommended at this stage. The boiler was installed in the premises in the early 1980's and should still be able to operate efficiently for at least the next 10 years (de Lange, 2006). The boiler is fitted with a heat exchanger that preheats the water that is converted to steam. The heat is supplied from a combination of a back-flow pipe from the boiler itself as well as from steam condensate returned from the processing areas. Although in the future, plans should be formulated to install a more environmentally friendly boiler when replacing the current one e.g. preferably electrical, otherwise oil burning. This is in line with trends of companies aspiring to reduce their environmental impact e.g. Johnson and Johnson in East London replaced their coal fired boiler with an oil fired one (Bobbins, 2006).

5.2.2.2 Operational changes

- The boiler is largely automated and only has one employee on duty in its vicinity when operational. This employee is responsible for ensuring that there is always enough coal on top of the automatic feeders. No changes in the current system are recommended.
- Figures 5.3 and 5.4 show that the setting of a target of averaging 56kg coal per ton of fruit processed is not unrealistic and would be a 7.5% saving with a value of R232 500-00 based on the 2006 coal price in the budget.
- Information gathered from Collondale Cannery which processed fruit only into juice concentrates in 2005 and 2006 show a coal consumption within 1kg/ton fruit processed to that of SPF Ltd. As SPF Ltd only requires a staff of 45 to operate its juice concentrate plant, this route is not recommended as it would result in wide-spread retrenchment with up to 800 employees affected (Bobbins, 2006).

5.2.2.3 Management and training

- Contracts with coal suppliers should always stipulate the size grade of coal required and penalty clauses should be included for failure to comply.
- Only coal with low sulphur content should be used as this burns more efficiently (Jones and Patefield, 2005). SPF Ltd currently requires its coal suppliers to supply coal specification sheets of the coal they supply. This coal typically has a sulphur content of 0.8% (Bobbins, 2006). Investigation into the most optimal way of operating the boiler should be undertaken i.e. should the factory process for 17 hours on the run or is the current method of two eight and a half hour shifts with a three and a half hour break more efficient.
- Figure 5.5 shows that at least 2700 tons of fruit should be processed per week to obtain the best efficiency of kg coal used per ton of fruit processed. This is in line with the recommendation made with water usage.
- As with the recommendations for water, commitment and training are crucial elements in any form of environmental management to help on the path to sustainability.
- Measurement of consumption should be Kg/ton fruit processed.
- By linking into an EMS, it would be possible to set targets for energy consumption.
- Coal usage reports should be presented and analysed at biweekly management meetings as well as weekly during production meetings to increase awareness in this area as well as to possibly identify measures that could result in improved efficiencies of coal use.

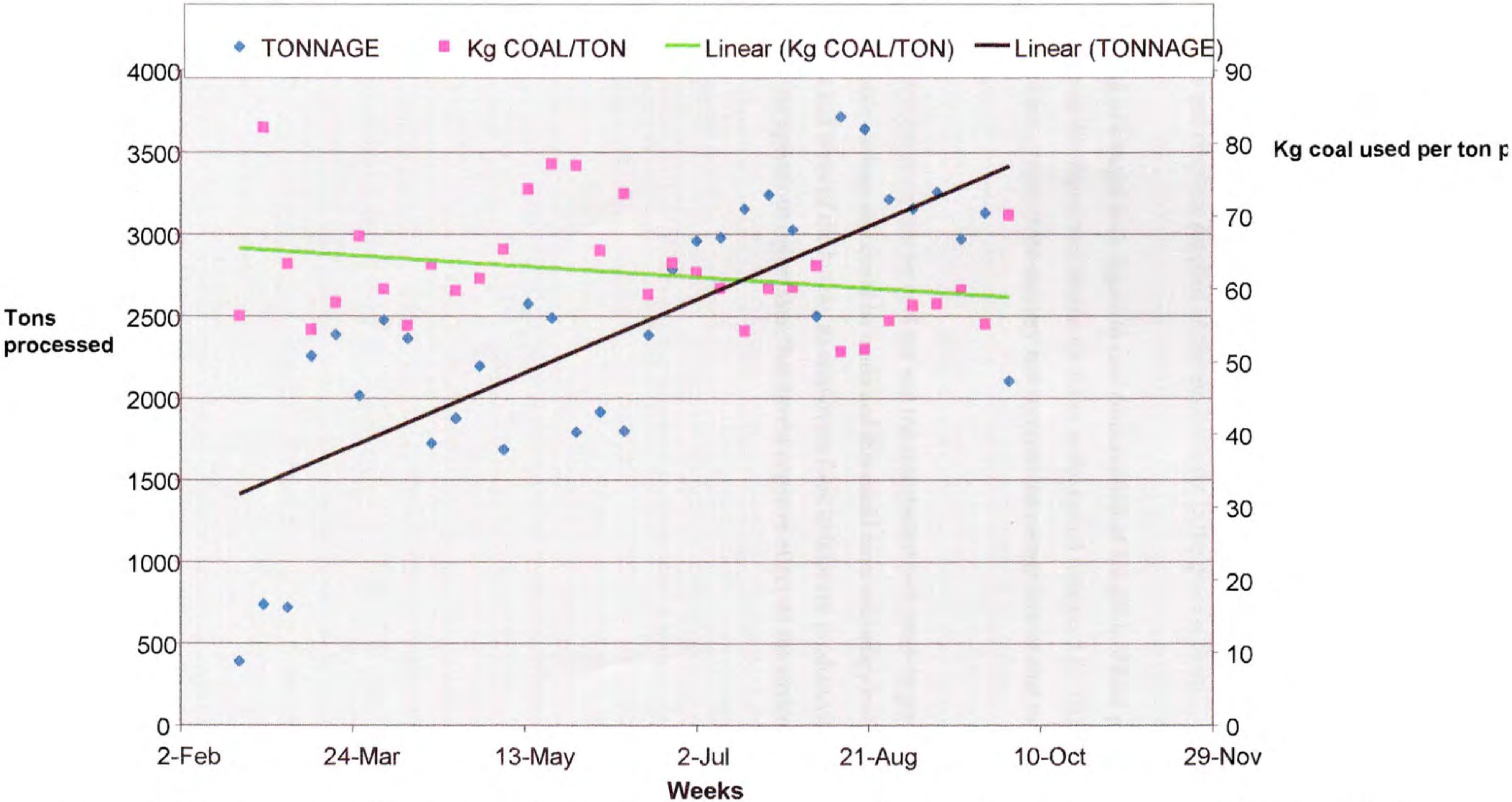

Figure 5.5 Trend analysis of tons pineapple processed vs Kg coal used per ton pineapple processed 19/02/06 -01/10/06

5.2.3 Conclusion: coal consumption

SPF Ltd might receive resistance from its coal supplier with regard to penalty clauses in its supply contract. This reiterates the importance of both eco-efficiency training and education. This also shows that it is important for all suppliers involved to understand the concept of environmental protection and to take stewardship of those areas where they can reduce the impact of their operations and resource supplies on the environment in the process chain.

The setting of a target with regard to coal consumption of 56kg/ton of fruit processed is not unrealistic as this figure was beaten six times in the period measured for this study. This figure may have been greater if the cannery had received the correct size of coal throughout the period of this study.

The presentation of reports on coal use and the cost thereof will result in greater awareness of what possible savings that could be made and this could have secondary effects in other operations and areas of the factory as employees look to improve productivities and to reduce the impact of the operations undertaken that have a negative effect on the environment.

CHAPTER 6: GENERAL DISCUSSION – STRATEGIC DEVELOPMENT OF SPF Ltd

SPF Ltd relies on the export market for nearly 80 percent of its turnover. It thus has to compete with the large producers and so concentrates on niche markets where there is a slight premium in the price. Some of the canned pineapple product in Thailand have also recognised the benefits of having an EMS and have achieved ISO 14001 certification e.g. Siam Foods who process 180 000 tons per year (Duncan, 2006). This is likely to result in more pressure on SPF Ltd in the long-term to also subscribe to such a program to at least be on the same footing rather than possibly being at a disadvantage as customers become more environmentally conscious and demanding.

SPF Ltd has no formal strategic development policy that it is striving to achieve as it focuses on overcoming the challenges identified in the literature review. This, in the opinion of the researcher is a major weakness that should be addressed. Being a minor producer in terms of world production of processed pineapple, SPF Ltd needs to target those markets that are prepared to pay a premium for its products as it cannot compete in the bulk markets supplied by the major processing countries in the Far East. The key market for SPF Ltd product is Europe where arguably consumers are more aware and concerned, compared to other geographical locations, about environmental issues such as climate change, food miles and carbon footprints. Climate change in particular is currently the focus of international concern. SPF Ltd should develop its environmental policy further and implement practices that reduce its total footprint and use these as a marketing tool in its sales.

The broad sense of sustainability requires an organisation to balance all three pillars of sustainability, namely economic, social and environmental. In this regard, South Africa is arguably at an advantage, being a young democracy. Organisations such as Fair Trade and the Max Havelaar Foundation are prepared to pay a premium for product that comes from poor or previously disadvantaged communities. SPF Ltd has been very involved in a pineapple growing project in the Peddie district of the Eastern Cape for some years. Both the organisations mentioned are now buying product from SPF Ltd as a result. Expansion of this project should be encouraged to create a win-win situation for both parties as SPF Ltd will receive a premium for its products sold to them and the pineapple project in Peddie receives an extra premium for the fruit it delivers to SPF Ltd and the communities involved in the Peddie project receive additional funds from these organisations for community projects. Thus it can be seen that there are benefits for any organisation that adopts an “ethical” approach to business by trying to balance the three pillars of sustainability and uses this approach as a marketing tool. SPF Ltd should develop a strategy that incorporates the three pillars of sustainability to ensure its own sustainability and to use as a marketing tool in those countries where such issues are on concern to the consumers, especially if they are prepared to pay a premium price for products.

Whilst the research findings only concentrated on water and coal use, it did not highlight many of the areas where SPF Ltd is already complying with the principles of cleaner production and eco-efficiency as discussed in the literature review. The aim of cleaner production and eco-efficiency practices also includes reducing costs and increasing efficiencies. Since SPF Ltd had no environmental policy at the start of the research and the policy since submitted by the researcher has not yet been formally adopted, many of the measures already in place that reduce the company's environmental impact overall are unintended rather than planned. In line with the principles of eco-efficiency as given by the ICC (1998), SPF Ltd already creates secondary income from both its waste peel which it sells to dairy farmers around East London and its coal ash which is sold to a brick making firm. Damaged cans and those for disposal after being opened for quality inspection are collected in a designated area, compressed and sent for recycling. Likewise paper, damaged or excess labels and cardboard is gathered and sent for recycling. Within the factory, the use of condensate for cleaning purposes in the juice plant was the idea of an engineering employee whose work station was this plant. By having no formal environmental program in place, these processes have never been recorded and as such have not been used as selling points in the market.

On the economic or financial side, SPF Ltd is not a "listed" company and its shareholders are the pineapple growers supplying it. The growers all have to be EUREPGAP compliant, initially in order for the company to be able to sell more easily into the European market and now to be able to export product (Dept of Agriculture, 2005). This standard requires a written commitment to protecting the environment and as such raises the possibility of compiling an LCA of pineapple production. Such information would be most useful when dealing with enquiries with regard to growing practices and possible chemical residue problems as well as being able to be used by the marketing department as a marketing tool.

From the above discussion, it can be seen that it will be necessary to have total management buy-in for the company to formally adopt and implement an EMS. As there are expenses involved, it will be crucial to have the commitment and support of the financial manager in this regard. Within the factory premises, SPF Ltd should be continuously looking for areas where it can apply either cleaner production or eco-efficiency principles. One of the first areas it should look at is its effluent. Currently the water is partially aerated which helps to reduce its chemical oxygen demand and is treated with lime to obtain a pH of between 7 and 10 before being released into the municipal effluent system. Being a pineapple processing factory, there is likely to be a high level of dissolved sugars within the effluent and with today's technology, it may be possible to harvest these and then to sell it as animal feed. Alternatively, the sugars may be beneficiated by other means. It is likely that in the future, there will be stricter conditions with regard to the quality of effluent discharged in terms of conductivity, total dissolved solids, biological oxygen demand etc. Plans should be made to deal with these issues before the Buffalo City Council makes them regulatory.

This research has shown that many benefits, both intentional and unintended that may be attained by aiming for increased environmental resource efficiencies. The best way to achieve these is by adopting a voluntary environmental code such as ISO 14001. The adoption of such a code will have three intended consequences: Firstly, by taking a professionalized approach to environmental management, there could be an increase in profitability of the company. This can result from using environmental considerations to motivate changes in production that are environmentally less damaging and economically profitable. Secondly, by implementing such a code, it can be used as be used as a tool to market a new and improved environmental image, so harnessing the benefits of having an excellent environmental reputation and dulling the environmentalist critique of the company's practices. In short, it would appear that the Porter Hypothesis, as discussed earlier in this thesis, would hold true for SPF Ltd. Further financial benefits related to improved environmental importance may be possible at SPF Ltd and these should be the subject of further research. The first step to achieving this is for SPF Ltd management buy-in and commitment to an EMS program with the ultimate goal of achieving ISO certification by the company.

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Appendix A: List of International convention, legislation and agreements with regard to environmental protection:

1. *"Convention Concerning the Protection of the World Cultural and Natural Heritage"* signed in Paris in 1972.
2. *"Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)"* signed in 1973.
3. *"Cocoyoc Declaration of 1974"* which addressed the issue of how to respect the "inner limit" of satisfying fundamental human needs within the "outer limits" of the Earth's carrying capacity.
4. *"Convention on Long-Range Transboundary Air Pollution (LRTAP)"* signed in 1979 and came into effect in 1983.
5. *"Convention on the Law of the Sea (LOSC)"* adopted by the UN in 1982.
6. *"Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (London Dumping Convention, LDC)"* adopted in London in 1972 and becam effective in 1975.
7. *"Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (Ramsar Convention or Wetlands Convention)"* adopted in 1971 and went into force in 1975.
8. *"Montreal Protocol on Substances That Deplete the Ozone Layer"* formulated in Montreal in 1987 and amended in 1990.
9. *"Declaration of the Conference on the Human Environment (Stockhlom Declaration)"* of 1972 to serve as a guide to national and international efforts to protect the environment.
10. *"World Conservation Strategy"* published in 1980, which stressed human responsibility for actions that affect the environment and launched sustainable development into the international policy arena, stressing the importance of integrating environmental protection and conservation values into the development process.
11. *"World Charter for Nature"* a nonbinding declaration adopted by the UN in 1982.
12. *"Man and the Biosphere Program (MAB)"* established by the UN in 1970 and devoted to improving the relationship of humans to the natural environment.
13. *'Brundtland Report"* published in 1987 and in which the term "sustainable development" was arguably first recognised.

(Environmental Science, 2006)

Appendix B: Site layout of Summerpride Foods Ltd

(Not to Scale)

Appendix B: Site layout of Summerpride Foods Ltd - Key

1 – Weekly Paid Canteen
2 – Female Team Leaders cloak room
3 – Weekly Paid Female Cloak room
4 – Weekly Male Cloak room
5 – Weekly Paid Male Ablutions
6 – Training Center
7 – First Aid
8 – Protective Clothing
9 – Male Team leader Cloak room
10 – Human Resources
11 – Laboratory Sample Storage
12 – Oil Store
13 – Coal Boiler
14 – Oil Boiler
15 – Central Stores & Offices
16 – Main Workshops
17 – Proposed Lime Store
18 - DPAC
19 - APV, Offices & Workshops
20 - Freezer Room A
21 - Freezer Room B
22 - Blast Freezer
23 - Transformer
24 - Warehouse A Cold Chain Drums
Empty Cans
Sugar
Canned Product
25 - Warehouse B Empty 210 lt Drums
Empty Cans
Concentrate

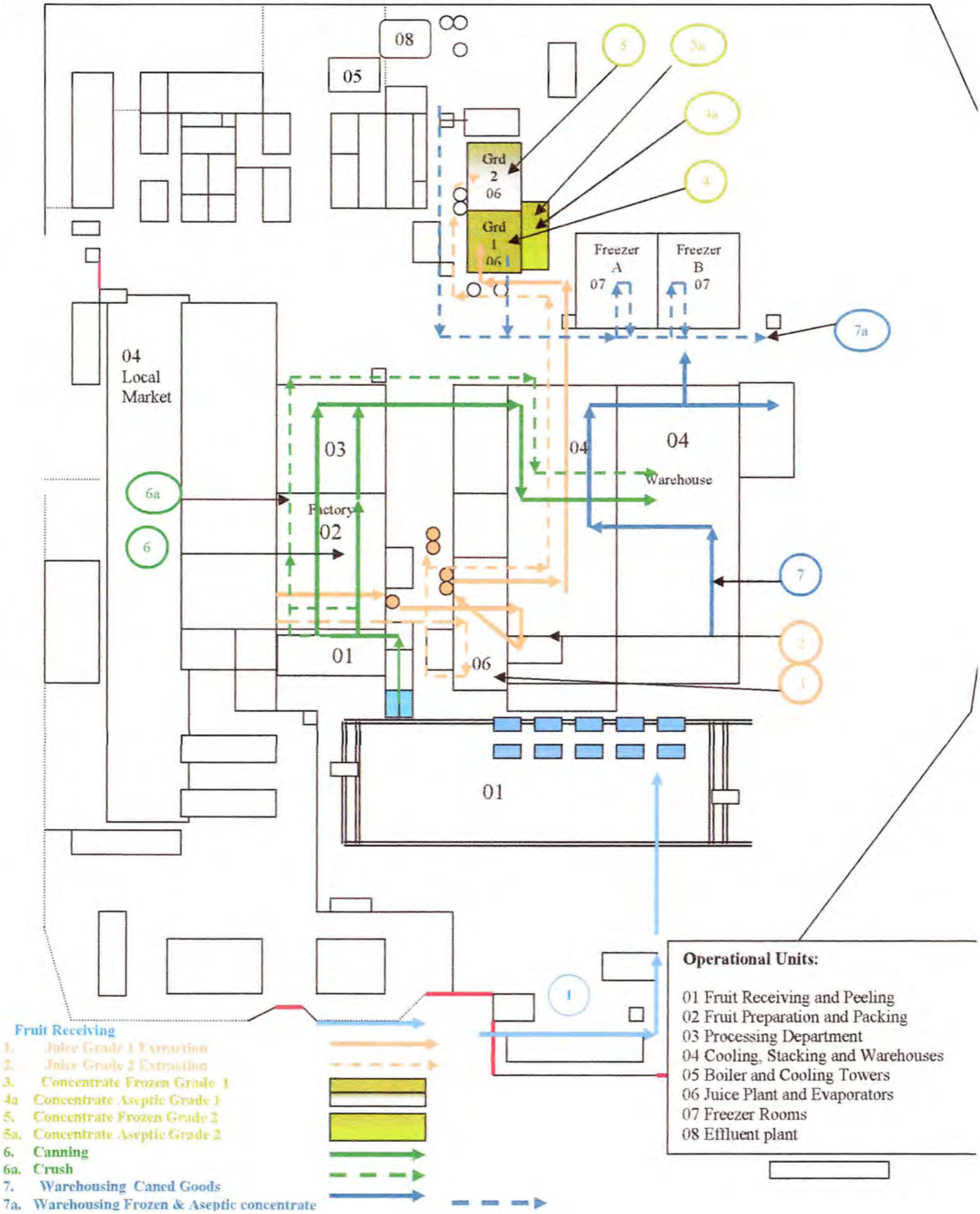
26 - Warehouse B Empty cans storage
Empty Can depalettising
27 - Local Market Warehouse
28 - Local Market Dispatch
29 - Monthly Paid Canteen
30 - Peeling Department
31 - Canning Hall
32 - Processing Department
33 - Juice House Workshop
34 - Juice House
35 - Laboratory (QC)
36 - Peeling Workshop
37 - Cooling & Stacking
38 - Labeling Lines
39 - Cooling Bays
40 - Juice House Store Room
41 - Label Pasting \ Label Store
42 - Warehouse C (Carton Storage)
43 - Export Product (Labeled)
44 - Export Loading Bay
45 - Visitors Room \ Recreation Room

1A - Weekly Paid Rest Area

24A - Carton Layer Pad Storage

46 - Car ports
47 - Main Administration Block
48 - Administration \ Boardroom \ Meeting Room
49 - Dockage & Weighbridge Area
50 - Fruit Receiving Area
51 - New Product Manufacturing Area \ Dryer
52 - New Product Research Lab\Kitchen
53 - Local Market Distribution Offices
54 - Bulk LP Gas Tank
55 - Waste Disposal Collection Area
56 - Effluent Dam \ Lime Dosing Area
57 - Drivers Rest Room
58 - Engineering Store Room

Appendix C: Fruit flow through SPF Ltd with Operational units identified



Appendix D: Effluent flow in Summerpride Foods Ltd