ASSESSMENT OF THE ECOLOGICAL FOOTPRINT OF THE WORLD SUMMIT ON SUSTAINABLE DEVELOPMENT

by

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ABSTRACT

With documented declines in the biophysical state of the planet, there is an increasing need to develop good environmental management tools to measure sustainability. Some of the traditional environmental management tools that are currently in use, such as Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs) do not adequately quantify sustainability for large events such as conferences, rock concerts and sporting events.

In this research, Ecological Footprint Analysis (EFA) is considered as a tool for assessing the sustainability of a large event, *viz.* the World Summit on Sustainable Development (WSSD). The WSSD, a follow-up to the 1992 United Nations' Conference on Environment and Development (UNCED), was held from 26 August to 4 September 2002 in Johannesburg, South Africa. It is the largest event of its kind in the world, with 80 635 registered (mostly international) delegates attending.

EFA can be considered as a tool to measure sustainability that converts consumption and waste production into units of equivalent land area. Based on the reality of biophysical limits to growth, and presenting data in an aggregated, quantifiable, yet easily comprehensible form, EFA is also a useful tool for environmental policy and management. EFA has typically been applied at national and regional levels, as well as in the assessment of technology. The application of the ecological footprint (EF) concept to a conference is the first of its kind undertaken. The case study shows conferences to be net importers of consumption items and thus dependent on a vast external environment. The EFA highlights those areas of consumption which constitute the largest part of the footprint and thus provides an opportunity for targeting those areas for proactive management. EFA for a conference clearly identifies that a reduced ecological footprint would mean a movement towards strong sustainability. Due to the vast resources consumed during a conference over a short period of time, initial observations and results show that conferences are ecologically unsustainable.

In estimating the EF of the WSSD, data were obtained on the following items: carbon emissions from electricity usage for the WSSD by conference venues and accommodation; carbon emissions from air and road transport used by delegates; total water consumed during the WSSD; catchment size required to cater for the volumes of water consumed; carbon emissions from the waste

generated; and carbon emissions from volumes of paper used during the WSSD. Data were sourced from various reports and service providers in the Johannesburg area.

The total partial EF of the WSSD was the sum of the sub-component footprints of electricity, transport, water, waste and paper. The EF of the WSSD was 2 522.08 ha, comprising an electricity EF of 93.03 ha, transport EF of 1002.86 ha, water EF of 1 406.14ha, waste EF of 0.45 ha and a paper EF of 19.60 ha. The footprint is 1.72% of the area of Johannesburg and 0.15% of Gauteng, but less than 0.01% the area of South Africa. The *per capita* EF of the WSSD was 0.03 ha, compared with South Africa's *per capita* EF of 4.02ha.

A number of recommendations are made for the reduction of the EF of large events such as the WSSD, and hence reducing their contribution to environmental degradation. Recommendations include the wider use and application of the EF concept, at the institutional and governmental level.

PREFACE

The work described in this dissertation was carried out in the School of Life and Environmental Sciences, University of KwaZulu-Natal, Durban from January 2002 to October 2004, under the supervision of Professor Roseanne Diab.

This study represents original work by the author and has not otherwise been submitted in any form for any degree or diploma to any tertiary institution. Where use has been made of the work of others, it is duly acknowledged in the text.

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Abbreviations

CBA	:	Cost Benefit Analysis
CFC	:	Chlorofluorocarbon
CMA	:	Cape Metropolitan Area
CSD	:	Commission for Sustainable Development
DEAT	:	Department of Environmental Affairs and Tourism
DPF	:	Diesel Particular Filters
DWAF	:	Department of Water Affairs and Forestry
EA	:	Environmental Assessment
EF	:	Ecological Footprint
EFA	:	Ecological Footprint Analysis
EIA	:	Environmental Impact Assessment
EMP	:	Environmental Management Programme
EMS	:	Environmental Management System
FAO	:	Food and Agricultural Organisation
GHG	:	Greenhouse Gas
ICC	:	International Convention Centre, Durban
IEM	:	Integrated Environmental Management
IPCC	:	Intergovernmental Panel on Climate Change
IUCN	:	International Union for the Conservation of Nature
JOWSCO	:	Johannesburg World Summit Company
LA21	:	Local Agenda 21
NASREC	:	National Sports, Recreation and Exhibition Centre
NEMA	:	National Environmental Management Act (Act 107 of 1998)
NEPAD	:	New Partnership for Africa's Development
NGO	:	Non-governmental Organisation
PBMR	:	Pebble Bed Modular Reactor
ROD	:	Record of Decision
SCC	:	Sandton Convention Centre

SEA	:	Strategic Environmental Assessment
UNA	:	University of Newcastle, Australia
UNCED	:	United Nations Conference on Environment and Development
UNEP	:	United Nations Environment Programme
URC	:	University of Redlands, California
WCED	:	World Council on Environment and Development
WSSD	:	World Summit on Sustainable Development
WWF	:	Worldwide Fund for Nature

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Additional thanks goes to Mickey Govender and Don Govender for their assistance in reviewing and editing the final document.

The completion of this thesis would not have been possible without the support, understanding and tolerance of my family, especially my son, Francesco. May Francesco prosper in a world with a strong sustainability ethic.

"*The earth provides enough to satisfy everybody's needs, but not every person's greed, when we take more than we need, we are simply taking from each other, borrowing from the future or destroying the environment and other species.*"

Mahatma Gandhi

CHAPTER ONE

INTRODUCTION

1.1 Background

The environmental impact of large events, such as conferences (e.g. the World Summit on Sustainable Development), sporting events (e.g. Soccer World Cup, Olympic Games), and music concerts (e.g. the 46664 AIDS Concert) has rarely been considered. Such events take place over short periods of time, often involve large numbers of people, consume vast quantities of resources, and generate much waste. Consequently, such events have significant implications for environmental sustainability. It is often difficult to measure the environmental impact or the environmental sustainability of such large events. Traditional sustainability tools such as Strategic Environmental Assessments (SEAs), Environmental Impact Assessments (EIAs), Environmental Auditing and Cost Benefit Analysis (CBAs), *inter alia,* have not been used to determine the environmental sustainability of large events.

International conferences have become a regular feature of the world, and in recent years South Africa has hosted some of the largest international events and conferences. The International Convention Centre (ICC), Durban, South Africa, alone has hosted over 63 national and international events since 1999 (See Appendix 1). Examples include the *Commonwealth Heads of Government Summit* (12/11/1999), *Getaway Show 1999* (17/11/1999), *XIII International Aids Conference (*07/07/2000-14/07/2000), *World Conference Against Racism, Racial Discrimination, Xenophobia and Related Intolerances (*31/08/01-7/09/2001), the *African Union Summit 2002* (01/07/2002-11/07/2002), the *World Summit on Sustainable Development (*26/08/02-04/09/02) and more recently, the *5th World Parks Congress (*08/09/2003-17/09/2003).

The World Summit on Sustainable Development (WSSD) held between 26 August 2002 and 4 September 2002 in Johannesburg was, to date, the largest conference held in South Africa and indeed, in the world (DEAT, 2003). It was aimed at addressing the key issues on sustainable development, yet ironically, the sustainability of the event itself has hitherto not been considered.

In an era where the pursuit of sustainability is pivotal to human endeavours, and large events have become commonplace, it is important to determine the environmental impacts of events such as the WSSD and to ensure that the ecological footprint (EF) associated with hosting such large events is measured and managed.

1.2 Rationale

The motivation to undertake this study emanated from a concern about the fate of human society as a result of the unsustainable lifestyle of many developed nations and affluent groups and current consumption patterns on the planet. This extravagant consumption pattern seems to be mirrored with increasing regularity across the globe when international events are hosted by particular nations. Such events generally involve large numbers of people traveling across continents, the consumption of relatively large amounts of energy, water and food and the generation of huge amounts of waste and pollution, which can often have significant impacts at the local level.

There is a need to interrogate the assumption that such large events pose a new form of "patch" disturbance (Rees, 2001) on the environment. It, therefore, becomes important to assess the environmental impact of such events to determine the extent to which they represent weak or strong sustainability. Such as assessment would facilitate the implementation of management plans that would further ensure that in the future, such events are within the carrying capacity of the local environment.

To the author's knowledge, this assessment of the impact of a conference is the first study of its kind. Some work was done for the 2000 Sydney Olympics and the 2002 Winter Olympics in Salt Lake City, in terms of assessing the environmental impact of these events (IUCN, 2003). However, this study represents the first application of Ecological Footprint Analysis (EFA) to a large event such as a conference.

EFA has been undertaken for a few cities, countries, and limited other applications. Some of these studies include a country EFA, e.g. Canada (Wackernagel and Rees, 1996), a city EFA, e.g. Cape Metropolitan Area (Gasson, 2000), university EFAs, e.g. University of Newcastle, Australia (Flint, 2001), and University of Redlands, California (Venetoulis, 2001), an EFA for a hospital, e.g. Lions Gate Hospital (Sibbald, 2002) and for an activity, such as salmon fishing in Canada (Tyedmers, 2000).

1.3 Aim and Objectives

The overall aim of this study is to assess the sustainability of the WSSD by means of EFA. The specific objectives of this research will be to:

- review the existing literature on ecological footprint (EF)
- provide a brief background on the WSSD
- estimate the EF of the WSSD, focusing on electricity, transport, water, paper consumed and waste generated
- compare the EF of the WSSD with that of other case studies
- evaluate the EF as a tool for sustainability assessment

Linked with the overall aim of this study, is a proposal that EFA is an appropriate tool that could be utilized to evaluate the impact of large events such as conferences, concerts, sporting events and holiday peak periods and therefore determine their sustainability.

EFA is an accounting tool that enables us to estimate the resource consumption and waste assimilation requirements of a defined human population, economy or activity (Wackernagel and Rees, 1996). The estimation of the EF for the WSSD will provide a benchmark for improving the "greening" efforts of future events and to promote the use of EF as a tool that could be used to ensure movement towards strong sustainability.

1.4 Structure of the Thesis

This thesis presents some of the theoretical issues that both inspired and informed the research and a case study of the EF of the WSSD.

Chapter One introduces the research context, presents the rationale, aim and objectives and the structure of the dissertation.

Chapter Two outlines sustainability and the EF concept. The focus in this chapter is on a discussion of what constitutes weak and strong sustainability, as well as the theoretical underpinnings of the EF concept. It begins by briefly introducing the multifaceted idea of sustainability and exploring in greater detail the competing "weak" and "strong" approaches to it. Within this context, the important yet contrasting roles that management tools are believed to play in the pursuit of sustainability are discussed, as are the ways in which the competing visions of sustainability reflect profoundly divergent worldviews. This is followed by a discussion of the need for biophysical techniques for evaluating human activities and includes a brief review of some of the more prominent methods currently in use. Some EF case studies are also discussed in this chapter.

Chapter Three discusses the methodology used in estimating the EF of the WSSD and provides information on data sources and methods of data capture for the WSSD.

Chapter Four presents the case study and the results of the EFA of the WSSD.

Chapter Five draws conclusions emanating from this research and makes some recommendations about EFA for future applications, particularly for large events such as conferences.

CHAPTER TWO

SUSTAINABILITY AND THE ECOLOGICAL FOOTPRINT CONCEPT

2.1 Weak and Strong Sustainability

Sustainability is a pathway or direction that the human population needs to move along so as to achieve greater balance between the social, economic and ecological environments. Sustainability is about applying the goals and principles of sustainable development, *viz.* "*Development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (World Commission on Environment and Development, 1987) so that we can achieve a better quality of life while protecting the integrity of ecosystems (Oelofse, 2000).

According to Wackernagel and Rees (1996) sustainable development is progressive social betterment without growing beyond ecological carrying capacity, whereas sustainability means living in material comfort and peacefully with each other within the means of nature. Development in this context implies getting better (realization of fuller and greater potential), as opposed to growth which means getting bigger (increase in size through material accretion) (Wackernagel and Rees, 1996).

According to Rees (2001), there are many divergent views about what sustainability really is, stemming from differing beliefs, values and assumptions about the nature of reality and humankind-environment relationships. These views range from the 'expansionist' or 'cornucopian' worldview to the 'ecological' or 'steady-state' worldview. The 'expansionist' worldview externalizes the problem, effectively blaming it on a defective environment which then needs to be fixed. The ecological view traces the current global environmental crisis to its source, *viz.* that nature and behaviour of people themselves are the main problem that require attention.

Very few people share a common vision of what sustainability is. Furthermore, researchers do not agree on a consistent theoretical foundation and set of indicators that can be used to analyse environmental impacts using sustainability criteria (Venetoulis, 2001). However, Pearce (1993) and Hajer (1995) distinguish between weak and strong sustainability. There is a wide spectrum of perspectives that range from technocentric, or 'very weak sustainability' to ecocentric or 'very strong sustainability'. This spectrum is important because it defines the way in which sustainable development is understood and operationalised.

Advocates of weak sustainability approaches assume that there is a high degree of substitutability between human capital and natural capital (Pearce *et al.,* 1990). Human capital is regarded as knowledge and skills, and human-created capital such as roads, schools, historic buildings, etc. Natural or environmental capital, on the other hand consist of, *inter alia,* clean air, fresh water, rainforests, the ozone layer and biological diversity.

From a development perspective, for strong sustainability it is important that developments with negative environmental impacts are managed as carefully as possible. The environmental impacts of some developments are existent throughout its life cycle i.e. from construction phase to operations and decommissioning stages. Some environmental impacts may be experienced many years after the event, e.g. during the operations, maintenance, decommissioning and dismantling stages of an event.

Strong sustainability must focus on an almost endless replacement of resources and minimum levels of environmental quality must be specified, before considering other goals of sustainability (Turner 1993). Strong versions of sustainability begin from a presumption that society cannot allow economic activity to result in a continual decline in the quality and functions of the environment, even though economic activities may be beneficial in other ways (Daly and Cobb, 1989). The so-called 'London School' of environmental economists, among others, has argued that a non-declining stock of natural capital over time is a necessary condition for sustainability, because sustainability limits production processes as well as other factors. This is a strong sustainability position, with natural capital fulfilling the role of the fair/just compensatory bequest to future generations (Pearce and Turner, 1990).

Gibbs *et al.* (1998), in describing the sustainability spectrum, focus on environmental policy within local government. The notions of weak and strong sustainability are applied in relation to the strength of integrative activity within environmental policy. When strong integration exists, departments within the organisation undergo a process of internal culture change, involving modification of strategic and operational characteristics. At the opposite end of the spectrum is weak integration, involving the adjustment of existing activities within existing operational boundaries. In this context, strong sustainability implies a complete overhaul of the existing structures and policies and the implementation of a totally new and different system. Practically, in the context of local government, such an overhaul and change in the system is not possible, within the constraints of current planning and development. Many local governments have recognised the need to focus on the natural environment at the same level at which social and policy considerations are addressed. Together with the Integrated Development Planning initiatives they have attempted to incorporate the normative concept of sustainable development by engaging in joint integrated planning and Strategic Environmental Assessments (Gibbs *et al.,* 1998).

One of the definitions that attempt to synthesise the many different views of sustainability is that of Gilbert *et al.,* (1996). They state, *inter alia*, that the concept of sustainability relates to the maintenance and enhancement of environmental, social and economic resources, in order to meet the needs of current and future generations. Sustainable development is integral to *intergenerational equity, intra-generational equity and carrying capacity.*

The three components of sustainability according to Gilbert *et al.* (1996) are:

(a) ***Environmental sustainability***, which requires that natural capital remains intact. This means that the source and sink functions of the environment should not be degraded. Therefore, the extraction of renewable resources should not exceed the rate at which they are renewed, and the absorptive capacity of the environment to assimilate wastes should not be exceeded. Furthermore, the extraction of non-renewable resources should be minimised and should not exceed agreed minimum strategic levels;

(b) ***Social sustainability***, which requires that the cohesion of society and its ability to work towards common goals be maintained. Individual needs, such as those for health and well-being, nutrition, shelter, education and cultural expression should be met;

(c) ***Economic sustainability***, which occurs when development, which moves towards social and environmental sustainability, is financially feasible.

However, many economists believe that weak sustainability is good enough. According to this view, society is sustainable provided that the aggregate stock of manufactured and natural assets is not decreasing. Thus weak sustainability allows the substitution of equivalent human-made capital for depleted natural capital. According to this view, the loss of the income-earning potential of a former forest is not a problem if part of the proceeds of liquidation has been invested in factories of equivalent income-earning potential (Miller, 1996).

By contrast, strong sustainability recognises the unaccounted ecological services and life-support functions performed by many forms of natural capital and the considerable risk associated with their irreversible loss. For example it is recognized that forests provide flood and erosion control, heat distribution, climate regulation, and a variety of non-market functions and values, in addition to wood fibre. Strong sustainability therefore requires that natural capital stocks be held constant independent of human-made capital (Miller, 1996). Manufactured capital stocks must also be held constant for strong sustainability so there is no capital depreciation of any kind. Many advocates of strong sustainability further agree that if population and material expectations rise, capital stocks should be enhanced.

Some examples of weak sustainability are best understood from the work of Pearce and Atkinson, as cited in Wackernagel and Rees (1996). These researchers ranked the sustainability of eighteen representative countries, starting from the weak sustainability assumption that natural and human-made capital are substitutable. They proposed that an economy is sustainable if it saves more (in monetary terms) than the depreciation of its human and natural capital. The results of this study indicated that Japan, Netherlands and Costa Rica headed the list of sustainable countries, while the poorest nations in Africa were identified as the most unsustainable. This study indicated the ecological irrelevance of weak sustainability. It failed to recognise that much of the so-called rich countries' money savings comes from the depletion of natural capital of other countries and exploitation of global common-pool assets. The apparent economic sustainability of both Japan and Netherlands depends on large-scale imports. In essence, high material standards are maintained by a massive but unaccounted ecological deficit with the rest of the world, including some countries that are labeled unsustainable (Wackernagel and Rees, 1996).

According to Wackernagel and Rees (1996), the current situation in the world of increasing stock depletion and rapid global change suggests that the remaining capital stocks are already inadequate to ensure long-term ecological stability. In these circumstances, strong sustainability is a necessary condition for ecologically sustainable development. This clearly implies that this condition can only be met if each generation inherits an adequate stock of essential biophysical assets that is no less than the stock of such assets inherited by the previous generation.

Although strong sustainability may be viewed as a radical conservation measure, the concept is still highly human-centred and narrowly functional. Emphasis is on the minimum biophysical requirements for human survival with little or no regard to other species. The preservation of biophysical assets essential to humankind does imply the direct protection of whole ecosystems and thousands of keystone species, and many other organisms would benefit indirectly (Wackernagel and Rees, 1996).

However maintaining the ecological bottom-line is not sufficient for sustainability. Certain minimal socio-economic conditions must also be met to ensure the necessary consensus for short-term action and long-term geo-political stability. Sustainability implies securing a satisfying quality of life for everyone. Most importantly, working towards the achievement of basic standards of material equity and social justice both within and between countries must continue. There also needs to be a shared commitment to a collective interest in the maintenance of the global commons (Wackernagel and Rees, 1996).

The principles of South Africa's National Environmental Management Act (Act No. 107 of 1998) (NEMA), provides clear guidelines for sustainable development. NEMA states, *inter alia* that environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably and that development must be socially, environmentally and economically sustainable. Sustainable development requires the consideration of eight relevant factors and the responsibility to consider the environmental health and safety consequences of a policy, programme, project, product, process, service or activity throughout its life cycle. Decisions must take into account the interests of all interested and affected parties and the right of workers to refuse work that is harmful to human health or the environment and to be informed of dangers, must be respected and protected. The Polluter Pays Principle (PPP) is applicable, where those who cause harm to the environment must pay for the clean-up and rehabilitation.

In pursuit of strong sustainability, many different tools have been applied to development projects, activities, *inter alia*. One of the more commonly used tools is environmental assessments.

2.2 Critical Analysis of Traditional Sustainability Tools

2.2.1 *Introduction*

The pursuit of sustainable development has been given greater focus in recent years. The 1992 United Nations Conference on Environment and Development (UNCED) gave greater impetus to the adoption of sustainable development principles.

The search for sustainability assumes that for any given proposed course of action, what is sustainable is known, i.e. the levels and thresholds of environmental carrying capacity for a region or for the entire world. Carrying capacity is usually defined as the average maximum number of individuals of a given species that can occupy a particular habitat without permanently impairing the productive capacity of that habitat (Rees, 2001).

There are a number of policy instruments directed to achieving sustainability. This study will focus only on two, *viz.* environmental policy instruments, and socio-economic instruments. Environmental policy instruments seek to protect or improve environmental quality, whereas socio-economic policy instruments are directed at achieving economic or social objectives.

The scope and application of environmental assessment (EA) instruments depend to a large extent, on the existing environmental, economic and social policy instruments and on how the EA process is integrated into regulatory procedures and practices (Lee and George 2000). Sustainability tools such as EA, which incorporates Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA), and Environmental Management Plans or Programmes (EMPs), Cost Benefit Analysis (CBAs), *inter alia*, have been used extensively in the pursuit of sustainability. However, an effective tool to ensure sustainable development or strong sustainability has been lacking. Most tools fall short of achieving true sustainability due to their inherent weaknesses. Of these, EAs, such as SEAs and EIAs, are the main and most frequently used traditional sustainability tools in South Africa (Mastri, 1996).

While in theory the principles of EA facilitate sustainable development, in practice, EAs sometimes fall short of supporting the strong sustainability perspective.

2.2.2 *Environmental Assessment (EIAs and SEAs)*

Agenda 21 provides a significant and essential, but challenging focus for current and future policy and may help to determine the effectiveness of the criteria by which the theory and practice of EA can be judged. Broadly speaking, the EA process, as an instrument that primarily predicts the consequences of development planning and decision-making can act as a crucial action, attempting sustainable development (Sadler, *et. al*, 1999).

EA covers both the appraisal of development policies, plans and programmes (through SEA), and the assessment of individual development projects, by an EIA. The purpose of both SEAs and EIAs, according to (Lee and George 2000) are to:

- Identify any potentially adverse environmental consequences of a development action, so that they may be avoided, reduced or otherwise taken into account during planning and design;
- Ensure that any such consequences are taken into account, both during the planning and design phase and during the authorization process;
- Influence how the development is subsequently managed during its implementation.

Over the past decades, EA have become national and international policy tools for limiting undesirable environmental consequences of development activities and for encouraging sustainable development (Lee and George 2000). Since the mid 1980s, many developing or less developed countries, including South Africa, have introduced EA policy instruments in various ways depending on their economic, social, political and environmental circumstances.

EA is now widely used to increase the likelihood that the adverse impacts of development proposals will be correctly identified and mitigated and as such constitutes a critical link between environment and development (Lee and George 2000). It demands that economic development take into consideration socio-cultural imperatives and the ecological consequences of economic transformation.

EA was conceived as a decision-making tool that made it possible to balance economic development and environmental protection. As part of the process, the concerns and interests of different parties are taken into account, and the contextual aspects of the decision are taken seriously.

According to Munn (1975), as cited by Lee and George (2000), at the project level, EA is known as EIA and is a procedure designed to identify and predict environmental impacts, and to interpret and communicate information about environmental impacts. In a regulatory context, the EIA must provide information that helps those concerned to make the best possible decision. EIA is not an isolated act in the decision-making process, but includes the gathering and incorporation of new information, publicising the proposals, discussions between interested parties, the amendment of proposals in the light of emerging legislative, social, economic or technical priorities and the learning process inherent in any impact assessment (Petts, 1999), cited by Lee and George (2000). Compared with many other mechanisms for environmental protection, EIA emphasises the prediction and prevention of impacts.

According to Lee and George (2000), SEA seeks to overcome deficiencies inherent in project-level EIA. SEAs help to incorporate sustainability principles into decision-making processes. As SEAs are becoming of interest to many countries, the methodology is continuously changing. It is intended to provide a broader context and a rationale for a sound and integrated decision-making process that can take the synergistic, cumulative, and indirect long-term effects of economic development seriously. SEA seeks to expand and integrate EIA into policy-making, planning and programme development.

EA provides a framework for assessing the environmental sustainability of development policies, projects and proposals. The concept of sustainable development is now accepted internationally as a basis for handling environmental issues and relating them to economic and social priorities. Agenda 21 and other declarations from the Rio Earth Summit held in 1992 provide benchmark principles and guidelines aimed at rigorously evaluating the extent to which economic development is in keeping with environmental sustainability. To this end, EA must place economic and social development in its environmental context (Lee and George, 2000).

EIA is a 'first-generation" assessment process that focuses primarily on identifying and mitigating the impacts of projects, be they new developments or significant alterations and/or expansions to an existing one (Lee and George 2000).

The arguments for the use of EIA vary in time and space depending on the perspective of those who use it. These perspectives range from those who reduce EIA to a mere administrative or regulatory exercise and a necessary evil to those who advocate the outright dismissal of all projects that carry a degree of risk and uncertainty. However, despite differences of opinion about the role of EIA, the EIA process is now viewed as a beneficial process that can help establish a harmonious relationship between development and environment (Lee and George, 2000).

One of the recent trends in EA is to apply EIA at earlier more strategic stages of development, *i.e.* at the level of policies, plans and programmes. Thus a SEA has emerged as a "second-generation" process that addresses both the sources and symptoms of environmental damage. SEA seeks to allow the principles of sustainability to be carried down from policies to individual projects. Lee and George (2000) indicate how SEA can assist in linking development projects to more sustainable policy, planning and programme development practices, through the development and more efficient application of environmentally integrated planning and policy levels.

In the Brundtlant Report, sustainable development is defined as "development which meets the needs of the present generations without compromising the ability of future generations to meet their own needs" (WCED 1987:53), cited by Lee and George (2000). The principles of sustainable development go beyond the concerns of economic growth. Sustainable development emphasizes the need for a change in the content of growth, *i.e.* growth needs to be less- material and energy-intensive and more equitable in its benefits. Sustainable development does not imply a fixed state of harmony between people and the environment, but instead a process of change in which the resource exploitation, investment decisions, technological development and institutional change are made consistent with future, as well as present needs (Lee and George 2000).

If developments that are likely to have a negative impact on the environment are necessary, it is better to deal with their potentially harmful effects in advance, at the planning stage, rather than rely on "crisis-management" when disaster strikes. This is in keeping with the precautionary principle, which states that preventive action should be taken, that environmental damage should be rectified at source, and that the polluter should pay (the so-called "polluter pays principle"). In some cases the best option would be to avoid the particular development completely (the "no-go" option).

Decision-makers and planners must, therefore strive to place economic and social development in their environmental framework. The UNCED held in 1992 recommended that international organisations and national governments should recognise the importance of the interaction of economic and social development and the natural environment, and the reciprocal impacts between human actions and the biophysical world. Development plans, policies, programmes and activities (such as a large gathering of people) in all sectors that do not take environmental concerns seriously cannot claim to be sustainable (Lee and George 2000). Environmental assessment, through the process of EIA and SEA, is an indispensable instrument for ensuring that, in any development project, the environment is taken into consideration.

Following the passing of the National Environmental Protection Act of 1969 in the USA, EIAs have been applied internationally to predict and mitigate the environmental impacts of developmental proposals (Sadler and Verheem, 1996). During this time, the EIA process has been through a number of revisions in an attempt to improve its effectiveness, including the use of social and economic impact assessment (Lee and George 2000).

In South Africa, EIA is defined as "A detailed study of the environmental consequences of a proposed course of action. An environmental assessment or evaluation is a study of the environmental effects of a decision, project, undertaking or activity. It is most often used within an Integrated Environmental Management (IEM) planning process, as a decision support tool to compare different options" (DEAT, 1998).

The principles of EIA were developed and promoted in South Africa in the form of Integrated Environmental Management (IEM) (DEAT, 1992). IEM has adopted broader principles than that of earlier EIAs, promoting transparent, participative and accountable environmental management for all stages *i.e.* planning, decision-making and implementation of development proposals (Lee and George 2000).

[According to (Regulation R1182, Environment Conservation Act, Act No. 73 of 1989)], a mandatory scoping report must be prepared for most projects included in a screening list of "*activities, which may have substantial detrimental effects on the environment*". However, a weakness is that the list of activities is not comprehensive and has excluded many activities that may have a detrimental effect on the environment, for example mining activities, telephone (Telkom) infrastructure, and large gatherings of people, such as sporting events and conference. Appendix 2 contains the list of activities according to Regulation R1182, Environment Conservation Act, Act No. 73 of 1989.

In South Africa, public participation is mandatory in the preparation of the scoping report and in the EIA. The reports are public documents, but not until after the approval decision on the environmental acceptability of the project has been made. These provisions reflect a general move from a more authoritarian tradition of decision making towards more participatory democracy. However the weakness of this is that the method for the involvement of interested and affected parties is not prescribed. There is a wide range of methods used by EIA practitioners, not all of which are effective. Often practitioners use a method that they are most familiar or comfortable with. Sometimes this is likely to be culturally or language insensitive, or may use communication mediums that are inappropriate and ineffective.

The decision-making power rests with the national environmental authority, *viz* DEAT for projects of national significance only. Decisions for projects at provincial or local (municipality) level are delegated to provincial government.

The EIA regulations aim to simplify and facilitate the EIA process and to minimise conflict around decisions that are informed by EIAs. However, serious conflicts of interest can arise in the EIA process when the state is both the decision-making authority and a party to the project application. Situations where conflict of interest can arise include:

- where the applicant holds a position of authority at a local, provincial or national level of government
- where the applicant is a statutory body or state-owned organisation
- where there is a public concern about the neutrality of the review authority

Decision-makers are accountable for their decisions to authorise proposed activities. Applicants are accountable for impacts they generate. These roles cannot be reconciled objectively when the applicant and the review authority and/or decision-maker hold positions that may potentially give rise to a conflict of interest.

An EIA process faces issues around conflict of interest if the applicant is either a government-funded organisation, a parastatal, a government-owned company or another government department (it is even possible for the authority and applicant to be the same organisation). The conflict of interest becomes more serious if the project has national (or strategic) implications, e.g. the Pebble Bed Modular Reactor (PBMR) Project in South Africa recently. The EIA process in South Africa does not, at present, suggest how this conflict should be resolved.

In this situation, the EIA process, as currently regulated, cannot be objective and unbiased if conflicts of interest arise and are unresolved. Individual EIAs and the process in general could be significantly harmed if the public and interested and affected parties do not believe that the IEM process is robustly honest and transparent (Council for the Environment, 1989). This is not to imply that all decisions involving government-linked applicants will automatically be biased. Rather, it is an issue of credibility, and for consultants involved in project management or specialist studies this could have serious professional implications. Here, it is pertinent to note that EIA regulations are very clear about the importance of consultants' independence, but do not address the implications of a non-independent decision-maker.

In view of the extensive decision-making and advisory powers granted to provincial authorities by the new regulations, this situation should be clearly addressed in order to prevent unnecessary conflict and appeals around the EIA process.
It is the responsibility of the authority to:

- ensure that the applicant or consultant complies with the requirements of the regulations
- ensure that the EIA evaluation, review and associated decision-making are conducted efficiently and within a reasonable time,
- make recommendations during authority review stages, and
- ensure that the reports and information submitted demonstrate that adequate expertise has been applied in the area of environmental concern, and that the EIA presents sufficient information on the policies, legislation and guidelines, etc. which

apply to the project.

Although relatively successful in identifying, assessing and mitigating project specific impacts, EIAs fail to address issues such as desirability of developments, potential cumulative impacts of the development, and the downstream impacts. The tendency of EIAs, in general, is to focus on the mitigation of project specific impacts, rather that determining justification for halting projects or assessing cumulative impacts of a project is well documented in international literature (Saddler, *et. al.*, 1996).

The implementation of the EIA regulations (*Regulation R1182*, Environment Conservation Act, Act No. 73 of 1989) requires that a certain level of capacity should exist within the relevant authority to successfully perform the assigned responsibilities. In order to carry out these responsibilities successfully, a certain minimum level of competence and capacity is required. In South Africa presently, it is doubtful whether any of the relevant authorities are able to perform all of these responsibilities at the level that the regulations require, especially in view of the vast number and variety of applications submitted to the authority. The complexities of the environmental issues involved and the format and style of many environmental impact reports (EIR) is exacerbated by an understaffed authority. This capacity problem is one of the main contributing factors that have led to regular delays in the issuing of the Record of Decision (ROD) from authorities for EIA applications. Many development projects are often hampered and some may even be cancelled due to unnecessary delays. Project costs could escalate due to lengthy delays and the concomitant escalation of other related costs such as fuel, materials and foreign exchange rate. Such delays could make some projects unviable. Of greater concern is that many projects may proceed without the ROD and the project may pose environmental problems or require more detailed studies on particular issues.

While there are guidelines for the various aspects in the EIA process, there is very little guidance on the time that should be taken to complete an EIA. Different consultants take different time periods to complete the EIA. Some EIAs run over many years, while others are completed within a few months.

Since the EIA regulations were promulgated in 1997, there has been a plethora of EIA consultancies established in South Africa. Individuals and groups with an assortment of experiences and qualifications have set themselves up to do EIAs, from environmental scientists, town and regional planners, biologists, ecologists, engineers, botanists, nature conservationists, horticulturists, surveyors, etc. Herein lies a major weakness of the EIA process in South Africa. It is likely that the quality of the EIA will be compromised and that the validity of technical content of Environmental Impact Reports (EIRs) could be questionable.

Only a handful of SEAs have been carried out in South Africa, including a regional SEA within KwaZulu-Natal. These SEAs add to the value of environmental assessments as a whole, as they are intended to appraise development policies, plans and programmes. The lack of SEAs raises questions about the long-term sustainability of many policies, programmes and plans (Lee and George, 2000).

In summary, some of the weaknesses associated with EAs as tools for sustainability in South Africa lie in the fact that EIAs are project specific and are regulated by the law which has some shortcomings. EIA regulations are not co-ordinated with other legislation. Furthermore, regulations are activity based and "substantial detrimental impact" is not well defined. Moreover, the list of activities in the current EIA regulations is not comprehensive. There are no norms or standards for EAs and the regulations are open to interpretation and value judgement.

In South Africa, other alternative assessment tools are not considered. Cumulative effects are not addressed. Sustainability issues are not adequately considered and there is little integration with regional planning and policy in EAs. Furthermore, the link between, and flow from, EIAs and EMPs is not clear. While the burden to ensure sustainability rests on the applicant, appeals are only permitted after the ROD is issued.

In view of the weaknesses of EA tools, there is a need for alternative sustainability tools. One such tool is EFA.

2.3 Ecological Footprint

2.3.1 *Definition of Ecological Footprint Concept*

The concept of an Ecological Footprint (EF) was developed in the mid-1990s by William Rees and Mathis Wackernagel at the School for Community and Regional Planning, University of British Columbia, Canada. EFA starts with the observation that within a given period of time, all consumption of energy and materials, and all discharge of wastes, requires a finite amount of land and water area for resource production and waste absorption (Wackernagel and Rees, 1996). The summation of land requirements for all the consumption items and discharge of wastes for a particular population produces a land area that is equivalent to the EF of that population (Wackernagel and Rees, 1996). An EF is thus a measure of the amount of land needed by a person or population. According to Wackernagel and Rees (1996), it is a far more useful indicator of sustainability than carrying capacity. According to Hoogervorst (2004), carrying capacity, in the case of organisms, is the maximum number of organisms that can be supported, fed or is able to survive in any specific habitat or ecosystem without causing the breakdown of the habitat or ecosystem.

Economic development involves extracting natural resources from the environment and transforming these into goods and services (Rees, 2001). Although these processes are necessary, they cause a certain amount of damage on the environment and also discharge harmful waste products into the environmental system. The balance between the development process and the carrying capacity of the environment should be adequately managed to foster sustainable development (Rees, 2001). Sustainable development is, to a large extent, influenced by the interplay between market forces and the environmental protection policies, as well as the government's social and economic policies (Rees, 2001). This interplay between market forces and the various government policies also influences the relationship between development and environmental quality.

Economic models of sustainability often ignore the issue that economic production requires continuous, irreversible energy and material transformations and that material consumption and waste production by the economy must be no greater than the resource production and waste assimilation capacity of the ecosphere. Humans, similar to all other species are also a 'patch disturbance' species. This implies that people invariably upset or disturb the systems of which they are a part, for example the clearing of forests for living space, agriculture and other human activities. Rees (2001) comments that humans, by nature, are a patch disturbance species, a distinction we share with other large mammals ranging from beavers to elephants. Large animals, due to their size, longevity, and food and habitat requirements tend to have substantial physical and systemic impacts on the ecosystems that sustain them. A patch-disturbance species may thus be defined as any organism which, usually by central place foraging, degrades a small 'central place' greatly and disturbs a much larger area away from the central core to a lesser extent (Rees, 2001).

Furthermore patch, disturbance is the measurable habitat and ecosystem modification caused by large animals, including humans, as they forage for food or other resources. Patch disturbance is most pronounced near the den site, temporary camp, or other 'central place' within the overall home range of the individual or group. This 'disturbance' to the ecosystem has become more pronounced recently due to technological advances, where natural systems and cycles are unable to cope or regenerate quickly enough (Rees, 2001).

It is short-sighted to assume that technology and expanding trade have infinitely expanded human carrying capacity and that humans will be able to survive (Rees, 2001). Carrying capacity is still very much applicable to humans, and given present trends, is likely to become a major focus of global development policy in coming decades. However, as shown in this study, there is a need for new approaches to the analysis of carrying capacity – methods that account for uniquely human cultural attributes, including trade and technology. EFA is one such analytic method.

The most recent work in this area (Chambers *et al.*, 2000) indicates that consumption of ecologically productive land across most countries is beyond renewable rates and globally there is "consumption gap" – consumption beyond the renewable services that the stock can provide over the course of a year (indefinitely) (Venetoulis, 2001). This consumption or sustainability gap is the global ecological deficit, i.e. the difference between any excessive human load on the ecosphere and the long term carrying (or load-bearing) capacity of the planet (Rees, 2001).

EFA is a quantitative tool that represents the ecological load imposed on the Earth by humans in spatial terms, *i.e.* the EF of a defined population (for example the attendees of a conference) is the total area of land and water ecosystems required to produce the resources that the population (conference delegates) consumes, and to assimilate the wastes that the population generates, wherever on Earth the relevant land/water are located (Rees, 2001). Eco-footprinting can be used to assess the ecosystem area effectively "appropriated" in support of any specified human population or economic activity. This can then be compared to available productive area, i.e. load-bearing capacity. The size and nature of the human EF is relevant to biodiversity conservation since energy and material resources extracted from nature to serve human purposes are irreversibly unavailable to other species. The larger the human footprint, the less non-human biodiversity (Rees, 2001).

EFA is also an accounting tool that enables the estimation of the resource consumption and waste assimilation requirements of a defined human population, economy or activity. EFs in the main have been calculated for some cities, countries and limited other activities, for example newspaper production and commuting in Canada (Wakernagel and Rees, 1996).

However, due to the magnitude of the WSSD and the anticipated impact on resources over a short period of time, the estimation of the EF of the WSSD is interesting from a sustainability point of view.

This study could also be used as a benchmark for the "greening" of future such events and to propose EF as a tool to be used increasingly to ensure strong sustainability for many developments, projects, programmes and events.

This is not to say one set of indicators or theory can fully capture the complexities of what sustainability means throughout time and space, much less quantify it without error. In fact, the diversity of approaches and indicators that are being utilized at the local and regional level has been welcomed cited in Rees (1996), ICLEI (1997); Hempel *et al.*, (1998), Hempel (1999), Mazmanian and Kraft (1999) by Venetoulis (2001). However, fundamental questions have remained difficult if not impossible to answer. For example: what and how big is a conference's environmental impact? Is it bigger than the area/city/province where it is hosted? If so, how much bigger? Without these basic questions, more difficult questions about whether or not the impact might be considered sustainable or not cannot be systematically answered. In light of this situation, it should not be surprising that many researchers and practitioners continue to use CBA and EIAs. Though some of this work has been of much use, it is not always well suited to answering the types of questions raised above. This is the case, in part, because the focus is singularly on economic implications (ignoring ecological impacts) or, in the case of EIAs, impacts are considered in a local or policy specific context (which can miss global sustainability dimensions associated with 'everyday' consumption/waste). Without an approach that can take into account global sustainability, those working on environmental assessment or greening of a conference or other similar events can find such assessments difficult.

Eco-footprinting starts from the premise that modern human beings are integral components of the ecosystems that support them and therefore still very much dependent on 'the land' (Rees, 2001; Wackernagel and Rees, 1996). The method also explicitly recognises that:

(a) whether one consumes locally-produced products or trade goods the 'land' connection remains intact, however removed from the point of consumption some of that land may be;

(b) that no matter how sophisticated technology, the production/consumption process requires some land- and water-based ecosystems services (Wakernagel and Rees 1996).

According to Rees (2001), EFA thus incorporates the trade and technology factors simply by inverting the standard carrying capacity ratio: rather than asking what population can be supported by a given area, eco-footprinting estimates how much area is needed to support a given population, regardless of the location of the land or the efficiency of relevant technologies. Eco-footprinting builds on traditional trophic ecology by constructing what is, in effect, an elaborate 'food-web' for the study population. This requires quantifying the material and energy flows supporting the population and identifying corresponding significant sources of resources and sinks for wastes. The human 'food-web' differs significantly from those of other species. In addition to the material and energy required to satisfy the metabolic requirements of our bodies, a human food-web must also account for our industrial metabolism (externalities).

Wakernagel and Rees (1996) further contend that eco-footprinting is based on the fact that many material and energy flows (resources consumption and waste production) can be converted into land- and water- area equivalents. These are the ecosystem areas required to produce the biophysical goods and services used by the study population. Thus, the EF of a specified population is the area of air, land and water ecosystems required, on a continuous basis, to produce the resources consumed and to assimilate the wastes generated by that population, wherever on Earth the relevant land/water may be located. A complete EFA would therefore include both the area the population 'appropriates' through commodity trade and the area it needs to provide its share of certain free land- and water-based services of nature, e.g. the carbon sink function.

The area of a given population's EFA actually depends on four factors, *viz.* the size of the population, their average material standard of living, the productivity of the land/water base, and the technological efficiency of resource harvesting, processing and use. Regardless of how these factors interact, eco-footprinting represents critical 'natural capital' requirements of the study population in terms of corresponding productive land and water area. It can also be considered that the EF is representing the extended 'patch' (productive habitat) occupied ecologically by the study population. It is critical to recognise that EFs represent ecologically exclusive areas. While two or more human groups may share in the output of the same exporting region, the total ecosystem area appropriated is the sum of the areas required by the individual populations. In the final analysis, all human populations are in competition for the available load-bearing capacity of the Earth (Rees, 2001).

In calculating the EF, it is best to err on the side of caution in making EF estimates. For example if there is a dispute over, or several estimates of, land productivity, the higher estimate is used (reduces footprint size). Most EF calculations are therefore likely to be under- rather than over- estimates (Rees, 2001). EFA calculates the total resource consumption and waste generation of a person, city, or nations (e.g. in tons) and, using land productivity factors (e.g. output in tons/ha) converts this consumption into the corresponding productive land area (e.g. ha) needed to produce the resources and consume the wastes. This area is the EF of the individual, city or nation. This enables a variety of EF comparisons to be made: of an individual person compared to the per capita "fair Earthshare" (Rees & Wackernagel, 1996) to establish the degree of over or under-consumption on a per capita basis; of a city compared to the area of its built footprint or its jurisdictional area to assess the degree to which its resource demands exceed the carrying capacity of its home region and are therefore being supplemented by appropriating the carrying capacity of other regions or nations; or of the global EF compared to the global extent of productive land to assess how close we are to the point of global overshoot.

EFA is an:
"...area-based indicator of sustainability that quantifies the intensity of human resource use and waste discharge activity in a specified area in relation to the area's capacity to provide for that activity" (Wackernagel, *et. al.*, 1996). EFA goes beyond the concept of 'carrying capacity'. Where carrying capacity determines what population a given area of land can support (capital/land area), EFA inverts the concept to calculate how large an area of productive land is needed to sustain a given population (land/capital) or economy "wherever on earth that land is located" (Walker and Rees, 1997). EFA recognizes the role of trade and technology in physically removing humanity from the limitations of their immediate geographical and ecological environment. Trade does not increase carrying capacity, but displaces the effects of consumption to the carrying capacity of some other part of the globe. Consequently, EFA is a measure of the carrying capacity of the whole planet and a tool with which to assess the human economy in terms of biophysical limits.

Single individuals, communities, a whole city or country have impacts on the earth's resources, because they consume the products and services of nature. Their ecological impact corresponds to the amount of nature they occupy to keep them going. Hence there is a dependence on ecological capacity to sustain themselves. A nation's or individual's EF corresponds to the aggregate land and water area in various ecosystem categories that is appropriated (or claimed) by that nation or individual to produce all the resources it consumes, and to absorb all the waste it generates on a continuous basis, using prevailing technology.

The EF compares renewable natural resource consumption with nature's biologically productive capacity. A country's footprint is the total area required to produce the food and fibres that country consumes, sustain its energy consumption, and give space for its infrastructure. People consume resources from all over the world, so their footprint can be thought of as the sum of these areas, wherever they are on the planet.

The global EF covered 13.7 billion ha in 1999, or 2.3 global ha per person (a global ha is 1 ha of average biological productivity) (WWF, 2002). This demand on nature can be compared with the Earth's productive capacity. About 11.4 billion ha, slightly less than a quarter of the Earth's surface, are biologically productive, harbouring the bulk of the planet's biomass production. The remaining three-quarters, including deserts, ice caps, and deep oceans, support comparatively low concentrations of bioproductivity. The productive quarter of the biosphere corresponded to an average 1.9 global ha per person in 1999. Therefore human consumption of natural resources that year overshot the Earth's biological capacity by about 20%. The global EF changes with population size, average consumption per person, and the kinds of production systems, or technologies, in use. The Earth's biological capacity changes with the size of the biologically productive area, and its average productivity per ha. Hence changes in population, consumption, and technology can narrow or widen the gap between humanity's footprint and the available biological capacity. It is apparent that, since the 1980s, humanity has been running an ecological deficit with the Earth (WWF, 2002).

Summing up the biologically productive land per capita world-wide of 0.25 ha of arable land, 0.6 ha of pasture, 0.6 ha of forest and 0.03 ha of built-up land show that there exist 1.5 ha per global citizen; and 2 ha once we also include the sea space. Not all that space is available to human uses as this area should also give room to the 30 million other species with which humanity shares this planet. According to the World Council on Environment and Development (WCED), at least 12% of the ecological capacity, representing all ecosystem types, should be preserved for biodiversity protection. This 12% may not be enough for securing biodiversity, but conserving more may not be politically feasible (WWF, 2002).

Accepting 12% as the magic number for biodiversity preservation, one can calculate that from the approximately 2 ha per capita of biologically productive area that exists on our planet, only 1.7 ha per capita are available for human use. These 1.7 ha become the ecological benchmark figure for comparing people's ecological footprints. It is the mathematical average of the current ecological reality. Therefore, with current population numbers, the average footprint needs to be reduced to this size. Clearly, some people may need more due to their particular circumstances but to compensate, others must therefore use less than the average amount available. Assuming no further ecological degradation, the amount of available biologically productive space will drop to 1 ha per capita once the world population reaches its predicted 10 billion. If current growth trends persist, this will happen in approximately than 30 years.

The use of EFA to estimate the EF of the WSSD has sustainability implications. This will be discussed in the context of ideal, strong and weak sustainability. These conceptual frameworks were liberally adapted from Barker, *et al.* (1997), who focus more clearly on the political and economic implications of weak, strong and ideal sustainable development, and Common (1996), who clearly draws the distinction between weak and other forms of sustainability.

As discussed earlier in this study, there are many and varied definitions of sustainability. Some versions focus on the interactions between governance, social responsibility, economy, ecology, and the distribution of benefits and costs among groups, while others may concentrate on just one or several of these or other factors. Arguably, an approach that balances out these different emphases has not reached definitive inter-subjective meaning among theorist, scholars, or practitioners. For some this means "sustainability" is without meaning, while others may see the need for substantial refinement (Viederman, 1996). While an interdisciplinary approach to sustainability can pose conceptual ambiguity, it has allowed room for open-minded theorists and practitioners to venture far-a-field in ways that have provided "thicker" meaning to the term. (Venetoulis, 2001).

Venetoulis (2001) contends that the three approaches to sustainability have one thing in common, *viz.* the use of natural services and capital beyond renewable rates are considered not to be sustainable. From all three perspectives, in addition to the WSSD's EFs, the other important piece of information needed to do a sustainability analysis is an area-based measure of how much ecologically productive land (services) is available on a renewable basis annually. The differences among the approaches lead to different answers about how much this amounts to and thus what, at least in part, constitutes sustainability.

Venetoulis (2001) asserts that an ideal approach to sustainability is premised upon the contention: living within the means of nature is sustainable when all consumption and absorption of ensuring waste occurs in the place where consumption directly occurs. The ideal approach implicitly holds that the allocation or availability of natural resources to support a population is predetermined by the "place" they live. So, the endowments of a place provide the empirical ecological limiting factor. From this perspective, the prospects for sustainability are limited to a footprint roughly the total size (area) of the main venues used for the WSSD. For the WSSD to be sustainable, the footprint should be equivalent or less than this area.

The two main differences that distinguish the weaker version of sustainability from the others are:

- The decline of specific natural factors of production (that would otherwise be unsustainable) can be offset through investment in (or submitted by) other (natural) productive factors; and
- Consumptive impacts are considered in a national context.

2.3.2 *Ecological Footprint Analysis Applications*

EFA has been used to calculate the land area requirements for populations in a geographically defined area such as the globe, a nation, or a region. Using six consumption items, Wackernagel and Rees (1996), estimated that the EF of Canada in 1991 was 4.3 ha/person. They then compared this with the EF of the United States of America (USA) which was 5.1 ha/person, India which was 0.4 ha/person and the world EF which was 1.8 ha/person. The average Canadian's footprint was therefore 2.33 times the world EF and 10.75 times that of an Indian EF. The EF of the USA was slightly higher than that of the Canadian EF which is not unexpected, as both countries are developed countries with high consumption patterns. Although there are more people in India, the consumption patterns (high fossil energy use, waste generation, etc.) in North America contribute significantly to a larger EF. This substantiates the recent assertion that one of the root causes of the environmental crisis facing the world today is the excessive consumption patterns of the minority affluent nations of the world (UNEP, 2000).

Building upon Rees' and his own work (Wackernagel and Rees, 1996), Wackernagel (1997) led a team of researchers that estimated the amount of ecologically productive land available on a global basis (Wackernagel, 1997).

Wackernagel and Rees (1996) calculated the EF of the Lower Fraser Valley in Vancouver, Canada and showed the population's land area requirement to be 19 times the geographical area of the region. The Lower Fraser Valley "appropriates" through trade and natural ecological flows, the productivity of an area 19 times the size of their home region in order to satisfy present consumption levels of food, forest, products and fossil fuels.

A study done by Simpson, *et al.* (1995), produced a draft report entitled, "Estimating the EF of the South-East Queensland Region of Australia. The per capita EF of the average resident of South East Queensland at 3.74 ha.

In 1995, a report by the International Institute for Environment and Development (IIED), reported that the land area or EF required to supply London's environmental needs, was 120 times the size of London (Wackernagel and Rees, 1996).
The report summarised the use of the EF concept in Britain and explored its potential contribution to official policy development and action by non-governmental organizations.

In 2000, Barrie Gasson of the School of Architecture and Planning at the University of Cape Town, delivered a paper at the International Association for Impact Assessment 2000 annual conference, entitled, "*Towards Ecologically Sustainable Cities: A Conceptual Framework and a Case Study*". The paper was the first recorded EFA in South Africa and focused on the Cape Metropolitan Area (CMA). According to Gasson (2000), this first approximation suggests that the CMAs EF is about 128 300 sq km which means that it depended upon an area of the earth's surface nearly equal to that of the whole of the Western Cape Province (129 370 sq km) for the supply of its resources and the absorption of its wastes. Its EF is 52 times larger than its jurisdictional area and 166 times the area of its built footprint. Its per capita EF is 4.28 ha which is slightly larger than South Africa's per capita EF of 4.02 ha. Both of these figures are significantly larger than the 1.9 ha of biologically productive land available per person globally in 1999 i.e. Cape Town is consuming twice its fair Earthshare (WWF, 2002). Comparisons between these figures and those of other cities are probably unrealistic because of the arbitrary extent of the jurisdictional area that is frequently used as the base urban area (Gasson, 2000).

In 1998, Kate Flint of the School of Geosciences, University of Newcastle, Australia (UNA), estimated the EF of the UNA (Flint, 2001). This study used the Wackernagel and Rees' (1996) consumption-land use matrix and incorporated the five consumption and six land use categories. The 14 items of consumption assessed in the EF of the UNA assimilated 3.59 ha of land. The results indicated that the UNA appropriates 26 times more land than its geographical space of 135 ha. Spatial impact of 26 times geographical area is greater than the spatial impacts calculated in footprint studies in both Europe and North America, but actually less than footprint analyses within Australia.

In 1998, Jason Venetoulis of the Environmental Studies Department, University of Redlands (URC), Redlands, California, USA, calculated the EF of the URC, using water, energy and waste output at the university. Taken together, the total measured EF of the URC in 1998 was approximately 2 300 ha (5 700 acres) or about 40 times the area of the actual campus (57ha/140 acres). The per capita footprint was 2.10 acres Venetoulis, 2001).

In 2000, Dr Susan Germaine determined that the Lions Gate Hospital in North Vancouver has an EF covering at least 2 841 ha, 739 times it actual size. The city of Vancouver's footprint is 180 times its total area (Sibbald, 2002). Wackernagel and Rees (1996) also calculated the EF of housing, commuting, tomato production, bridges and newspapers in Canada.

Peter Horst Tyedmers of the Department of Applied Earth Science, at the University of British Columbia, Vancouver, undertook doctoral research in 2000, entitled "*Salmon and Sustainability: The Biophysical Cost of Producing Salmon Through the Commercial Salmon Fishery and the Intensive Salmon Culture Industry*". The results of both the EF and energy analyses indicate that salmon farming is the least biophysically efficient and hence least sustainable system for producing salmon currently operating in British Columbia.

Technologies, including transport and agricultural methods, and lifestyle choices such as residential densities have also been assessed by EFA for planning purposes (Walker and Rees, 1997). When using EFA for this purpose, the conclusion is reached that a reduced footprint equates to a more sustainable technology or system.

EFA has been undertaken for some cities in the US, Canada and Europe. All these studies indicate that the EFs of these cities are larger by more than 10 times the area that the populations inhabit.

These studies and others reveal that the natural services now being consumed in many places throughout the world are having an impact that is in excess of nature's renewable productivity and assimilative capacity. This means that the stock of nature's capital is being used up to fill the "consumption gap". If this persists over enough time, one possible result is a decrease in the amount of life (including people) that can be supported even at subsistence levels.

2.3.3 *Ecological Footprint Analysis - A Tool for Sustainability*

According to Wackernagel, *et al.* (1997), the strength of EF as a sustainability tool lies in its numerous advantages. The EF of most countries is larger than what their own ecosystems can support. On a global basis, humanity's footprint has overshot global capacities by at least 35%. This frames the sustainability challenge: it shows the extent to which humanity's economic activities have to become less resource consumptive and less contaminating. It also assists in comprehending the ecological impact of humanity's growth, with its doubling in the next half century. This proves that footprints of most countries are too large.

The future is risky when strong sustainability is little understood, and there is little understanding of humanity's present status on the planet, or where humans are headed. In contrast, understanding ecological constraints and identifying future risks supports informed decision-making. This reduces threatening uncertainties and points to new opportunities, thereby providing a good indication of where humans are on the environment-development continuum. The statistical information compiled during EFA calculations can be used for various other biophysical assessments, thereby allowing the extraction of other insights from the compiled data sets (Wackernagel, *et al.*, 1997).

Wackernagel, *et al.* (1997) states that the footprint numbers point to obvious equity implications. They reveal the extent to which wealthy people and countries have already "appropriated" the productive capacity of the biosphere. Based on the conservative assumption that the wealthy quarter of humanity consumes three quarters of all the world's resources, this wealthy quarter alone already occupies a footprint as large as the entire biological capacity of the earth. Furthermore, such over consumption is hard to compensate for. Simple mathematics show that consuming three times the amount available per capita in the world (as is typical in industrialized countries) implies that for each over consumer there have to be three other people using one third of the global average. Otherwise humanity is not within sustainable limits. More specific and socially stratified footprint assessments can also shed light on equity within countries. This may show that the highest income quintile of countries like Argentina, Botswana, Brazil, Chile, Guatemala, Mexico or Malaysia may live on footprints at least as large as those typical for industrial nations. EFA shows the impact of both consumption and population. The biggest share of the planet's bounty is taken by high levels of consumption in industrialized countries. But with ever larger populations it becomes progressively less likely that a reasonable quality of life can be secured for everybody.

Rapidly growing populations will lose their prospects even faster. Population growth is first and foremost a local problem. This translates to the fact that the benefits of reducing demographic growth will also remain local. For example, there is on average only 1.7 biologically productive ha available per person, assuming the fragmented 12% of nature suffices to secure biodiversity. Population growth and ecological deterioration are reducing this area even more. They key question is therefore: how can humans squeeze high and attractive quality of life out of these 1.7 ha. Further experiments and case studies are required to highlight this question and show how humans can best live within these limits (Wackernagel, *et al.*, 1997).

Biophysical assessments which are an integral part of EFA, can summarise progress toward sustainability by tracking and comparing the ecological situation on a yearly basis, as done with economic indicators. For every scale, from the globe down to the nation, the region, the municipality, the business or household, measures of natural capital such as the EF can point out to what extent communities or nations are approaching sustainability. EFA becomes a starting point for more detailed local comparisons and time series. Historical analysis can show the path of the past and illuminate to what extent economic and demographic growth have enlarged a nation's or region's footprint. Also, they offer themselves as indicators of countries' potential vulnerability and their contribution to global ecological decline. The EF method provides a systems approach for global, national, regional, local and personal natural capital accounting that can trace demand and supply. As natural capital accounts document ecological risk and social equity, EFA could complement Gross Domestic Product (GDP) measurements. Planners and administrators of each country will have a tool to analyse the ecological state of their country on issues such as: the extent to which a country can support the consumption of its people; the trends in a nation's dependence on nature; the potential "interests" that the national natural capital can yield; and the extent to which these interests are used. EFA identifies missed opportunities and highlights potential risks. In this way, they help avoid dangerous over exploitation and finding sustainable options (Wackernagel, *et al.*, 1997).

Wackernagel *et al.* (1997) further contend that confusion about what sustainability means has slowed down progress. This confusion, infused with unnecessary conceptual complexity has been convenient for those who are interested in preserving the status quo, such as industrialists and capitalists. Such delaying also undermines the exercise of precaution. It is now necessary to move beyond the Bruntland definition and assess sustainability in concrete terms. Only clear and measurable objectives help to better manage sustainability. Simple benchmarks that compare human consumption with nature's limited supply help refocus public attention on the sustainability challenge. They clarify ecological boundary conditions and make way for meaningful debates on development. By providing common ground, such assessments build bridges between different world views and they amplify the resonance between all disciplines working on sustainability. From there, shared visions for a sustainable future can be built.

With this simple and reproducible evaluation tool at hand, governments, businesses and NGOs can adapt the EF for better national assessments (for example sectorial analysis). Also, they can redesign it for other tasks such as budget reviews, technology and policy assessments or "eco-labeling". In this way, they can detect whether their own initiatives are moving in the right direction. NGOs can audit more effectively to determine whether "sustainable" initiatives of government and business really hold what they promise. In this way, these checks can reveal whether initiatives are effective or if they are merely "sustainable posing" or "green wash". After all, in an ecologically overloaded and inequitable world, only those projects that improve people's quality of life while reducing humanity's resource consumption and waste production promote sustainability (Wackernagel, *et al.*, 1997).

According to Wackernagel, *et al.* (1997), NGOs and governments can use footprinting not only to assess progress, but also to make local sustainability efforts work. Many people, in government, businesses and at the grassroots level, know that humanity lives beyond ecological capacities, but are not willing to act. Therefore, the bottleneck for action is seldom "information". On the contrary, too much information on problems that seem overwhelming demoralizes people. Rather, information needs to be accessible and appropriate. To encourage people's participation, it has to show the positive impact of a proposed action. By summarising ecological impacts in perceivable units, the message becomes simpler. It also provides easily understandable feedback by revealing how much ecological capacity has been or can be saved, and what benefits can be expected by proposed programmes or projects.

Such simple sustainability tools become powerful educational resources, from primary school to university level. They can integrate sustainability thinking in all kinds of subjects: science, mathematics, geography, arts, social studies, etc. as demonstrated by already existing curricula. Such courses not only provide tools but also stimulate interest and sow enthusiasm for a better future. They become the building blocks for positive changes in a spirit of co-operation. Biophysical examinations of humanity's resource throughput reveal why there is such rapid loss of biodiversity. Human activities just occupy too much space. Footprint numbers illustrate the basic premise of sustainability and conserving biodiversity: the need to live with nature, within its regenerative and waste assimilation capacity and with other species with which the planet is shared. Analysing humanity's dependence on nature underlines the often forgotten fact that humans are part of nature. This is often ignored in the development of cities, machines and economies. Understanding humanity's relationship with nature requires first hand experiences. However, most of the influential decision-makers are city people, who live in a world psychologically shielded from this basic reality. Biophysical assessments may help those who lack these experiences to grasp the implication of the "forgotten fact" that humanity is an integral component of the global ecosystem (Wackernagel, *et al.*, 1997).

Traditional scientific thinking fragments issues and can get people lost in details. In contrast, the EF helps us to see the "big picture" of current reality. It shows the connections between the environmental issues and puts them in a quantitative perspective. It clarifies the links between resource constraints and social conflicts. This is what is required presently to comprehend the sustainability challenges: systems thinking and numeracy that goes beyond percentages. People must understand magnitudes – the magnitude of the human load as compared to the magnitude of the planet's finite carrying capacity (Wackernagel, *et al.*, 1997).

Clear and accessible measurements of humanity's overuse of nature can help explore human and social psychology. One large obstacle to sustainability is the cleft between "realizing" the ecological and social crisis, and "doing" something about it. As long as people deny addiction to a materialistic, but in the end highly destructive lifestyle, humans may not be able to close the gap between realisation and action. Simple sustainability concepts with easily understandable measurements may allow exploration of people's perception, fears and willingness to act. This may help to explain the apparent lack of urgency to get sustainability going, and to find strategic intervention points for effective programmes (Wackernagel, *et al.*, 1997).

According to Wakernagel and Rees (1997), sustainability stands for finding satisfying ways of life for all, within the capacity of the planet, now and in the future. In other words, sustainability depends on acknowledging that there are natural biological and physical limits to what humans can take from nature, agreeing roughly on where humans stand now in relation to those limits and understanding that in order to reduce human impact equitably, those that take the most will be required to scale back the most. EFA is a tool to address these underlying sustainability questions. More specifically, it addresses equity from three different angles. Firstly, it addresses intergenerational (between generations over time) equity where the EF measures the extent to which humanity is using nature's resources faster than they can regenerate. Depleting this natural capital leads to an ecological debt that will have to be paid by future generations. Through national and international (in the current time period, within and across nations) equity, EF demonstrates who uses how much. It does this across nations. Secondly, it calculates EF for different groups within society, such as different income sectors. Thirdly, EF shows to what extent people dominate the biosphere at the expense of wild species, *viz.* interspecies (between species) equity.

Because EFA is a reproducible methodology, there are possible positive spin-offs, the main one being the introduction of a tool that can be used for similar research on countries, regions, cities, universities, primary activities, and other major events (entertainment, sports, conferences, holiday destinations, etc.) towards promoting strong sustainability.

CHAPTER THREE

DATA AND METHODOLOGY

3.1 Description of Case Study

The World Summit on Sustainable Development (WSSD), held from 26 August to 4 September 2002, was hosted by South Africa in Johannesburg, Gauteng. The WSSD is the largest international conference held in South Africa to date and indeed, is regarded as the biggest conference to be held worldwide (DEAT, 2003). The total number of accredited and non-accredited delegates who attended the WSSD and the range of parallel events was 80 635 (DEAT, 2003), including 105 heads of state. Altogether, 180 countries were officially represented. In addition, 500 parallel events took place in Johannesburg and elsewhere in the country during this period. Full details of delegates, their accommodation and the associated services provided are given in Appendix 3.

The purpose of the WSSD was to review progress in implementing Agenda 21 and the plan of action for sustainable development that was agreed on at the 1992 United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil. UNCED, also commonly referred to as the *Rio Earth Summit*, was held on the 20th anniversary of the first international Conference on the Human Environment, held in Stockholm, Sweden in 1972. UNCED brought together policy makers, diplomats, scientists, media personnel and Non-Governmental Organisation (NGO) representatives from 179 countries in an effort to reconcile the impact of human socio-economic activities on the environment and *vice versa*. Running parallel with UNCED was a Global NGO Forum, which was attended by an unprecedented number of NGO representatives who outlined their own vision of the future of the environmental, socio-economic and developmental state of the world. Some of the outcomes of UNCED included Agenda 21 (a list of 21 actions required to address environmental degradation), the Rio Declaration and the establishment of the Commission for Sustainable Development (CSD) (DEAT, 2003).

The WSSD, commonly referred to as "Rio + 10", brought together world governments, concerned citizens, United Nations agencies, multilateral financial institutions and other major actors to assess global change since the historic UNCED. Unprecedented gains for development and environment were made, resulting in the adoption of the Johannesburg Declaration on Sustainable Development and the Johannesburg Programme of Implementation. Furthermore, a number of partnership deals were struck to provide resources to implement Agenda 21 (DEAT, 2003).

The WSSD emphasized the balance of the three pillars of sustainable development, *viz.* social development, economic growth and the protection of the environment. This was a decisive shift from the widely held perspective over the past decades that sustainable development equaled protection of the environment. The WSSD also emphatically pronounced that sustainable development cannot be achieved separately from the quest to eradicate poverty and that the growing gap between the rich and the poor is one of the biggest threats to sustainable development. Related to this was the decision to establish the World Poverty Relief Fund. There was a major shift from the donor/recipient paradigm to one which focused on the obstacles to economic growth in poor countries posed by an unfair global economic system. While there was agreement to increase aid from rich to poor countries, there was, more importantly, an acknowledgment that by far, the biggest obstacles to poverty eradication are lack of market access and the anti-poor trade system (DEAT, 2003).

Of particular interest to Africa, was that the cause of the African continent was greatly advanced with a practical focus on the New Partnership for Africa's Development (NEPAD). The WSSD further served to advance the cause of multilateralism during this troubled time in the world. It asserted the centrality of the United Nations and called for democratic global governance. Through these focused goals, the WSSD brought global focus on the state of the environment and renewed high-level commitment to environmental protection. The WSSD also provided many jobs and injected approximately R8 billion into the South African economy (DEAT, 2003).

To sustain the conference and its numerous activities and side events, a vast amount of resources essential to, but not readily associated with conferencing were required. With no internal production of consumption items, the WSSD was a gross importer of consumption requirements. Energy, transport, buildings, food, services and consumables are essential for the effective functioning of all the activities of a historic summit such as the WSSD and hence had to be imported from external systems. The WSSD also relied on the external environment as the destination for exported waste products. Given the size of the WSSD and its global importance, the WSSD was likely to affect the environment with an impact similar to that of a small to medium sized city or community (DEAT, 2003). Therefore, it is appropriate to conduct an EFA for a conference of this magnitude, and the results will be as instructive to environmental management as an EFA conducted for cities and regions.

3.2 Calculation of the Ecological Footprint of the WSSD

3.2.1 Background

EFA can be used to assess the associated environmental impacts of processes, events, areas or items, such as food or fuel, for example. This research is a partial footprint calculation based on five consumption items relevant to the WSSD, *viz.* energy (electricity footprint), transportation (transport footprint), water (water footprint), solid waste (waste footprint) and paper (paper footprint). The above-mentioned sub-components of a fully comprehensive EFA were focused on in an effort to account for consumption that was of ecological significance and to make the task manageable over the course of the WSSD, due to bounding problems. It is likely that electricity usage, impacts from air and ground transportation, water consumption, waste generation and paper usage (during the WSSD) will have the greatest environmental impacts. Consequently, these components are expected to contribute the greatest proportion to the EF of the WSSD, justifying the focus on a subset of items.

The electricity footprint focuses on the electricity consumed during the WSSD at the accommodation and conference venues. Electricity consumed by the organizing teams in the planning period prior to the WSSD, in the various preparatory meetings and in preparations by delegates in their own countries was not included in the calculation of the electricity footprint.

In estimating the transport footprint, carbon emissions from air and ground transport utilized during the WSSD are taken into account. Transport used by the organizing teams prior to the WSSD and for the various preparatory meetings and preparations by delegates in their own countries was not included in the calculation of the transport footprint. Likewise, in the calculation of the water, waste and paper footprints, the calculations were based on consumption of water and paper and production of waste during the actual period of the WSSD and were confined to official conference venues and accommodation venues only. Furthermore, the activities and environmental aspects associated with the logistical arrangements, for example road construction, materials production, venue construction and preparation, were also not included in the calculation of the EF of the WSSD.

The five footprints mentioned above were estimated over the ten day period of the WSSD, although it is acknowledged that impacts extend over a much longer period and include, for example, pre-summit planning meetings, such as Preparatory Committee Meetings in New York, Paris and Bali, and the South African delegation bids at various United Nations forums. Furthermore, within each sub-category, assumptions were made to simplify computations. For example, in the estimation of the transport footprint, only travel by air and associated usage of fuel was considered. A more exhaustive analysis might have also included delegate travel by road to Johannesburg.

Notwithstanding the limitations and the fact that the findings presented in this thesis only reflect part of the WSSD's total ecological impact, it is contended that even this partial EF will provide a valuable indication of the sustainability implications of a large conference such as the WSSD.

3.2.2 Methodology and Data Sources

The methodology used in this study is based largely on the work of Wackernagel and Rees (1996) and that of Gasson (2000).

3.2.2.1 Summary of the Methodology

Rees (2001) provides simple guidelines for the calculation of EF. The first step in calculating an EF of a study population is to compile the total (annual) consumption of each significant commodity or consumer good (represented by subscript *i*) used by that population. Thus the population's consumption of item *i* can be represented as follows:

$$\textbf{Consumption}_i = \textbf{production}_i + \textbf{imports}_i - \textbf{exports}_i \text{ (Rees, 2001)}$$

In the case of a conference there is no internal production nor exports, consequently consumption is equivalent to imports.

The second step is to convert consumption of each item into the land area required to produce that item by dividing total consumption by the area conversion factor, *viz.* land productivity or yield in kilograms per ha.

This gives the EF of each individual item (EF_i). Thus

$$EF_i = \frac{\text{total consumption of item } (i) \text{ in kilograms}}{\text{area conversion factor}} \qquad \text{(Rees, 2001)}$$

The total EF of the population (EF_p) is determined by summing the footprints of the 'n' individual items:

$$EF_p = \sum_{i=1}^{n} EF_i$$

Finally, the per capita ecological footprint (EF_c) is obtained by dividing the total population footprint by population size (N):

$$EF_c = EF_p/N$$

For some wastes such as carbon dioxide emissions, or nutrients such as phosphates and nitrates, it is also possible to calculate the land (or aquatic) ecosystem area required for sustainable assimilation and recycling. In such cases, the assimilation rate per ha and per year is substituted for yield (area conversion factor) (Rees, 2001).

Double-counting is avoided whenever identified. For example, in the analysis of a particular city's EF, to account for food-related nutrient assimilation, only the agricultural and forest products footprint components should be compiled in the total footprint analysis, even though a city's domestic wastes are composted and spread on adjacent agricultural or commercial forest land. Similarly, some consumer products such as leather goods are the by-product of another industry (in this case, beef production). In such cases only the primary land requirements (the grazing and grain lands required for feeding cattle) would be considered.

For the WSSD, it was necessary to calculate the quantity of carbon emitted as a result of electricity generation, transport use and paper production, as well as the amount of water and paper used and the amount of waste generated. Appropriate area conversion factors also had to be determined. These included the land required to assimilate the carbon and waste generated, the land to cater for the water and paper used (the latter being equivalent to the number of ha of forests required to produce the trees for the paper) as well as the landfill space required for the waste disposal.

Thus the individual footprints are given as follows:

$$EF_{Electricity} = \frac{\text{total carbon produced from electricity use}}{\text{area conversion factor}}$$

$$EF_{Transport} = \frac{\text{total carbon produced from transport use}}{\text{area conversion factor}}$$

$$EF_{Water} = \frac{\text{total water use}}{\text{area conversion factor}}$$

$$EF_{Waste} = \frac{\text{total amount of carbon generated from waste}}{\text{area conversion factor}} + \frac{\text{total waste generation}}{\text{area conversion factor}}$$

$$EF_{Paper} = \frac{\text{total carbon emitted from paper production}}{\text{area conversion factor}} + \frac{\text{trees required for paper}}{\text{area conversion factor}}$$

Therefore the $EF_{WSSD} = EF_{Electricity} + EF_{Transport} + EF_{Water} + EF_{Waste} + EF_{Paper}$

Rees (2001) asserts that to estimate typical population EFs, for whole regions or countries, world average land productivities or yields are used. This greatly simplifies calculations since there is no need to trace all the sources of trade goods and waste sinks or determine the productivity and assimilative capacities of the corresponding production/assimilation areas. Using a common base yield facilitates comparison among countries and comparisons of individual countries with global totals.

According to Rees (2001), for some kinds of analysis, it is necessary or useful to base the eco-footprint calculation on actual land/water yields where sources are known and data are available. Further, to compare a country's or region's eco-footprint with the productive or load-bearing capacity of its domestic territory, the actual productivity of various domestic land categories (cropland, pasture land, forests, carbon sinks) and other categories must be known in order to calculate the country's 'ecological deficit' (or surplus). An ecological deficit exists when the 'load' imposed by a given human population on its own territory or habitat (for example region, country) exceeds the productive capacity of that habitat. In these circumstances, if it wishes to avoid permanent damage to its local ecosystems, the population must use some biophysical goods and services imported from elsewhere or alternately, lower its material standards.

The total human load imposed on the environment by a specified population is the product of population size times average *per capita* resource consumption and waste production. The concept of load capacity recognizes that human carrying capacity is a function not only of population size but also of aggregate material and energy throughput. Thus, the human carrying capacity of a defined habitat is its maximum load that can be sustained by the specific community. According to Wackernagel and Rees (1996), the EF concept is based on the idea that for every item of material or energy consumption, a certain amount of land in one or more ecosystem categories is required to provide the consumption-related resource flows and waste sinks. Thus to determine the total land area required to support the WSSD, the land-use implications of each significant consumption category need to be estimated. Since it was not practical to assess land requirements for the provision, maintenance and disposal of each of the hundreds of consumer goods for the WSSD, the calculations were confined to a select group of major categories, *viz.* electricity, transport, waste, water and paper, that are likely to have the greatest impact on resource use at the WSSD.

According to Gasson (2003, pers comm.)[1], there are two main ways to calculate the EF. These are:

(a) The conversion of per capita resource consumption and waste production into the related productive and absorptive land areas. The per capita figure is then multiplied by the total population to give the total EF. This is often the preferred route in the absence of data on overall metabolism rates.

(b) Converting the overall metabolic inputs and outputs for the population into the related productive and absorptive land area.

The second method has been followed in the case of the EF for the WSSD to produce a partial (and first approximation) of its EF. This draws on previous work by Gasson (2000) and recent work by Rand (2002).

It is necessary to calculate the total tons of carbon emitted during the WSSD from the total CO_2 emissions data, as the energy footprint will be the net assimilation capacity of a carbon sink (for example forest) and not CO_2. (Rees, 2004, pers. comm.)[2]. A molecule of carbon dioxide (CO_2) consists of one atom of carbon (atomic weight = 12) and two atoms of oxygen (atomic weight = 16) for a total molecular weight of 44. This means that the proportion of carbon by mass in any quantity of CO_2 is constant at 12/44 or 3/11.

Therefore, tons of carbon is the product of tons of CO_2 and the factor 3/11, expressed as an equation as:

$$\text{Tons of carbon} = \text{tons of } CO_2 \times 3/11.$$

The area conversion factor used for the EF of the WSSD is 75 tons of global carbon fixation per ha (Edinburgh Centre for Carbon Management, 2002). The rationale for using this area conversion factor rather than the 1.8 tons per ha per year assimilation rate of Wackernagel and Rees (1996), is that this is a better assimilation rate for a short-term event, whereas the 1.8 tons per ha per year assimilation rate is the area conversion factor for annual emissions. As the WSSD is not an annual event, it is not appropriate to calculate the eco-footprint in terms of the total area of carbon-sink forest required to neutralize carbon emissions on a continuous basis.

Annual sequestration rates are actually not relevant to the WSSD. The EF of a specified population or economic activity is normally defined as the area of land and water ecosystems required on a continuous annual basis by that population (or activity) to produce the resources that the population/activity consumes and to assimilate its wastes. This implies that the eco-footprint normally estimates the on-going demand for ecosystems services by a permanent population (for example the city of London) or activity (for example fish-farming) recognizing that there will be fluctuations over time with changing life-styles, incomes and technology (Rees, 2004, pers. comm.)[2].

The situation is different for a short-term event. The annual sequestration rate is not valid for estimating the annualized EF of a ten-day event (Rees, 2004, pers comm.)[1]. The conference is over and while the carbon is out there being circulated and partly assimilated all over the world, there is no on-going demand for assimilative services. One needs to determine the area of more or less stable carbon sink that would be required to contain all the carbon released by the WSSD, which was for only ten days.

Data collection is inherently difficult in EF assessments due to the confidential nature of data, costs and because data are not collected in an appropriate format (Simpson *et al.*, 1998). These problems were encountered in the EFA of the WSSD, although to some extent, the problems were minimized by the "local" scale of the assessment required for the conference, *viz.* the focus on impacts within a defined geographical area, *viz.* Johannesburg.

The Governing Body of WSSD, commissioned a study of the carbon footprint of the WSSD. This was undertaken by the Johannesburg Climate Legacy and documented in a report entitled *Carbon Footprint for the WSSD* (Governing Body of the WSSD, 2002). Although the report is entitled the *Carbon Footprint for the WSSD,* the report merely calculated the total carbon emitted by various processes during the WSSD. An EFA was not done to calculate the actual footprint of the WSSD-related carbon emissions.

This document was used extensively to provide the data needed to calculate the electricity, transport, waste, paper and water footprints. Other data came from GroundWork, an Environmental Consultancy engaged by International Union for the Conservation of Nature (IUCN) for the 'greening" of the WSSD and various publications from the South African Department of Environmental Affairs and Tourism (DEAT). Some data were obtained through telephone and e-mail requests as well as many individual meetings.

3.2.2.2 *Estimating the Electricity Footprint*

The electricity footprint can be estimated as the quotient of the total carbon emissions from electricity (converted from total CO_2 emissions by multiplying by a factor of 3/11) and the area conversion fact of 75 tons of carbon fixation/ha (Edinburgh Centre for Carbon Management, 2002).

Electricity consumption figures for the relevant venues were obtained from the carbon footprint calculated by the Johannesburg Climate Legacy Project (Governing Body for WSSD, 2002). The main conference venues used during the WSSD for the various meetings, workshops and exhibitions were the Sandton Convention Centre (SCC), Wanderers Cricket Stadium (used for the Ubuntu Village), National Sports, Recreation and Exhibition Centre (NASREC), Hilton Hotel, Nedcor (Sandton), and MTN Dome (Waterdome). Electricity consumption for the accommodation of the delegates was estimated by the Johannesburg Climate Legacy Project (Governing Body for WSSD, 2002) and these data were summed to the estimate the electricity footprint of the WSSD. It is likely that the electricity consumption at these venues would have risen sharply during the WSSD due to the activities and large number of delegates.

The electricity consumption is estimated from the average consumption of electricity used by 80 635 delegates living in and around Gauteng during the ten days of the WSSD. The hotels and venues used for the WSSD consumed the most electricity, and average figures were only from these venues (Governing Body for WSSD, 2002). This method took into consideration the electricity use of all the delegates, irrespective of where they lived during the WSSD.

3.2.2.3 *Estimating the Transport Footprint*

One of the main sources of CO_2 emissions was from air and ground transportation used to transport the 80 635 delegates to Gauteng, South Africa, and transport them between the different conference venues and accommodation facilities. Work done by the Johannesburg Climate Legacy Project in calculating the Carbon Footprint (Governing Body for WSSD, 2002) provided the input data for the transport footprint.

To calculate the transport footprint, it was necessary to know the total distance traveled by air by all delegates, both local and international, to the WSSD and the total distance traveled by road between accommodation and conference venues. The total kilometres traveled is worked out in three stages, *viz.* international air travel to Johannesburg, domestic travel to Johannesburg from within South Africa and road travel used during the WSSD to travel between accommodation and conference venues.

The data included in this section are based on travel to the WSSD by the registered delegates only. Furthermore, it does not include travel before or after the WSSD, nor transport used by organisers and the various service providers. Neither does it include the travel of local residents who left Johannesburg during the busy period of the WSSD. Most traveled to holiday destinations, especially as South African schools were closed during this time. The total road distance traveled during the WSSD by the delegates was calculated as the product of the average distance traveled during the day by the 80 635 delegates and the duration (ten days) of the WSSD.

The contribution of transport to CO_2 emissions during the WSSD, was calculated from the sum of the:

- resulting CO_2 emissions from participant air travel to host city (international)
- resulting CO_2 emissions from participant air travel to host city (local)
- resulting CO_2 emissions from participant road travel between hotels and venues.

The transport footprint is, therefore, the quotient of the total carbon emissions from transportation (converted from total CO_2 emissions by multiplying by a factor of 3/11) and the area conversion fact of 75 tons of carbon fixation/ha (Edinburgh Centre for Carbon Management, 2002). Transportation infrastructure such as airports, roads, paths, bus shelters, parking areas, *inter alia*, was not considered in estimating the transport footprint. These elements could have increased the transport EF.

3.2.2.4 *Estimating the Water Footprint*

Water is one of the resources that are used extensively during a conference for cooking, cleaning, sanitation, laundry, *inter alia*. To obtain the water footprint, one of the following two methods could be applied (B. Gasson, 2004, pers. comm.)[1].

Method A

1. Establish the Assured Annual Yield (AAY) of the dams supplying Johannesburg
2. Calculate the proportion and quantity of AAY assigned to urban uses

3. Calculate the proportion of AAY for urban uses consumed by WSSD
4. Apply that proportional figure to the total catchment area to calculate the proportional footprint area.

Method B

1. Establish Johannesburg's actual urban water consumption in 2002
2. Calculate the proportion of this consumed by WSSD
3. Apply that proportional figure to the total catchment to obtain the proportional footprint

Method A is based on potential *i.e.* assured annual flows and is likely to result in a smaller footprint - on the assumption that the assured annual flow is larger than the actual amount consumed. Method B is based on actual 2002 urban use, and gives a real proportion of WSSD in relation to this, and a related footprint that is possibly larger than Method A. For ease of calculations and data acquisition, Method B was used in this study.

To calculate the total amount of water that was consumed during the WSSD to meet the electricity needs of the WSSD, the energy use for the accommodation and conference venues were summed and multiplied by the Eskom conversion factor of 1.27 litres water/kWh electricity generated (Eskom, 2003).

The total water consumed during the WSSD was then estimated as the sum of the water from electricity use and the water consumed by the NASREC Expo Centre, Wanderers Stadium, Sandton Convention Centre, Hilton Hotel, Nedcor (Sandton) and the Waterdome.

Using Method B as described above, the water footprint was then estimated as the quotient of the total water consumed during the WSSD and the conversion factor of the proportional figure to the total catchment area, *viz.*

$$\text{Area conversion factor} = \frac{\text{Total Water used during WSSD}}{\text{Total Johannesburg Water Consumption 2002}}$$

This proportional value (area conversion factor) was then multiplied by the Vaal catchment area to obtain the equivalent catchment that would have been required to provide the water needs of the WSSD, *i.e.* the water footprint.

To account for water consumption, data on the total consumption during the WSSD were obtained from Johannesburg Water for the City of Johannesburg, the South Africa Department of Water Affairs and Forestry (DWAF) and the *Carbon Footprint for the WSSD* (Governing Body for WSSD, 2002).

To estimate the water footprint, data on the total water consumed during the WSSD for the generation of electricity, the use of water at the six main conference venues and an estimate for accommodation use were required, as these three components would have contributed the most to the water footprint.

The maintenance, accounting or billing departments of the following also provided data for the period of the WSSD:

(a) Johannesburg Water – data on total water consumption in Johannesburg during 2002 and total water consumed during the WSSD at the Dome.

(b) Sandton Convention Centre – water consumption data

(c) Hilton Hotel – water consumption data

(d) Nedcor (Sandton) – water consumption data

An estimate of the water consumed by delegates at accommodation venues for showering, washing, laundry, ablutions, etc., was made at 60 litres (30*l* morning and 30*l* night) per delegate per day. This use is likely to be significant due to the large number of delegates in the area over a short period of time. However, the water used for irrigation purposes for food production to supply the needs of the delegates at the WSSD was not taken into consideration.

The challenge in calculating the water footprint is to settle on a rational way to work out the water footprint of a short-run event. The volume of water consumed is important as it indicates that water consumption during the WSSD was one of the dominant components of all the resource/metabolic flows at WSSD. However, it does not convert directly into the two-dimensional area from which the flows came.

To calculate the area conversion factor (required catchment to supply the water needs of the WSSD) the total consumption of water during the WSSD as well as the total water consumed in Johannesburg during 2002 was determined. The catchment size supplying water to Johannesburg was also required. According to the Johannesburg City website, the Vaal Catchment provides all the water needs of Johannesburg.

The increasing demands in the Vaal River System Supply Area, the natural resources of the Vaal Dam catchment are unable to supply the full water requirements. (http://www.dwaf.gov.za/orange/Vaal/vaaldam.htm). Various interbasin transfers exist to transfer water from areas with excess resources to the Vaal Dam catchment. Two such schemes are the Lesotho Highlands Water Project (LHWP) (comprising the Katse and Mohale Dams) and the Tugela-Vaal Scheme (comprising the Thukela Catchment). Hence the total size of the catchments feeding into the Vaal Dam is the sum of the Vaal catchment (3 850 000 ha), the LHWP catchment (280 700 ha) and the Thukela Catchment (2 900 000 ha), which is 7 030 700 ha.

Though not without its shortcomings, the water footprint provides an area-based measure that can be incorporated into the EFA framework. It also affords a way to begin to address regional variations in water availability (or scarcity) which has hitherto been a sticking point in methodological advancement in EFA.

3.2.2.5 *Estimating the Waste Footprint*

Due to the size of the event, the generation of waste was an important component of the EF of the WSSD. Vast quantities of solid waste were generated and disposed of at the conference venue sites and the accommodation facilities during the WSSD. The waste data were estimated for both accommodation and conference venue waste generation.

The total waste disposed off in 2002 in Johannesburg, as well as the total size of the five landfill sites were provided by Pikitup, the waste management company responsible for waste management in Johannesburg.

The area conversion factor is calculated as the quotient of the total waste generated during the WSSD and the total waste generated in Johannesburg in 2002, *viz.*

$$\text{Area conversion factor} = \frac{\text{Total WSSD waste}}{\text{Total waste in Johannesburg in 2002}}$$

This proportional value (area conversion factor) was then multiplied by the total landfill area for Johannesburg.

The total CO_2 emitted from the waste is calculated as the product of the total waste, the methane emission factor of 0.13 kg CH_4 per ton waste and the Global Warming potential of CH_4 of 21 (Governing Body for WSSD, 2002). The forest required to assimilate the carbon produced from waste disposal is the quotient of the total carbon emissions from waste (converted from total CO_2 emissions by multiplying by a factor of 3/11) and the area conversion fact of 75 tons of carbon fixation/ha (Edinburgh Centre for Carbon Management, 2002).

The waste footprint is therefore the sum of the landfill and forest areas required to appropriate the waste and the carbon emissions.

3.2.2.6 Estimating the Paper Footprint

The WSSD produced large quantities of paper in the form of the numerous publications, newspapers, documents, *inter alia*, which is likely to have a significant impact. According to the IUCN (2003), approximately 25 tons of paper was used at the WSSD. The energy required to produce one ton of paper is 1 215 kWh (Governing Body for WSSD, 2002). The fossil energy used in the harvesting and manufacturing process is included as part of the total carbon sink for the population or process under consideration (Rees, 2004, pers. comm.)[2]. The forest area required for paper would be included as a component of the total exclusive forest area required to produce the wood to manufacture the paper for the WSSD.

To calculate the CO_2 emissions from paper use, the energy consumption (in kWh) per ton of paper were multiplied by the total tons of paper used at the WSSD, *viz.* 1215kWh/ton x 25 tons.

The kWh electricity used was then converted to MWh by dividing by 1 000. The CO_2 emission was obtained as the product of the kWh electricity generated by the paper production and the Eskom conversion factor of 0.979 tons/MWh (Governing Body for WSSD, 2002).

The total forest area required to produce the wood needed for the paper used at the WSSD is expressed as the quotient of the total tons of paper and the area conversion factor according to Wackernagel and Rees (1996), *viz.* that one ton of paper is made from 1.8m^3 of wood which requires 2,3m^3/ha/yr of trees.

The paper footprint is therefore the sum of the landfill and forest areas required to appropriate the forest land needed to assimilate carbon emitted in the production process for the paper and the amount of forest required for the trees to produce the paper.

3.3 Limitations of the EFA of the WSSD

There are many limitations and shortcomings associated with undertaking an EFA for a huge event such as the WSSD. Calculating the EF of a conference is a challenging and difficult eco-footprint project particularly because of 'bounding problems'. Identifying consumption items that are attributable only to the WSSD (i.e. consumption/waste production that would not take place were the conference not to occur) and the problem of getting adequate data on all conference-related energy and material flows were some of the main challenges (Rees, 2004, pers. comm.)[2].

Most footprint analyses are of whole political jurisdictions where records of production, trade and consumption are kept by statistical agencies, so the latter problem is not so acute. When eco-footprint analysis is applied to individual activities such as the case for the WSSD or in 'comparative technology assessment', close co-operation of many people is necessary in order to trace all the energy and material demands. Many problems were encountered in bounding the analysis and in gaining the trust of people from whom data were needed.

Calculations were based on the assumption that the current industrial harvest practices are sustainable, which they are not in reality (Rees, 2001). Only the five basic consumption items were used in assessing the partial EF of the WSSD. Other activities at the WSSD directly and indirectly appropriate nature's services through the use of renewable and non-renewable resources, waste absorption, paving over, soil contamination, and other forms of pollution, e.g. ozone depletion. This study concentrated on electricity, transport, waste, water and paper only.

One other significant consumption item, *viz.* food was not considered, due to the problems associated with collating information on the quantities and different types of foods consumed during the WSSD at the various many different conference venues as well as food outlets and home hospitality accommodation, all across Gauteng. Crop, pasture, and forest land required for the production of food and other consumer goods were not considered.

CHAPTER FOUR

ANALYSIS OF THE ECOLOGICAL FOOTPRINT OF THE WORLD SUMMIT ON SUSTAINABLE DEVELOPMENT

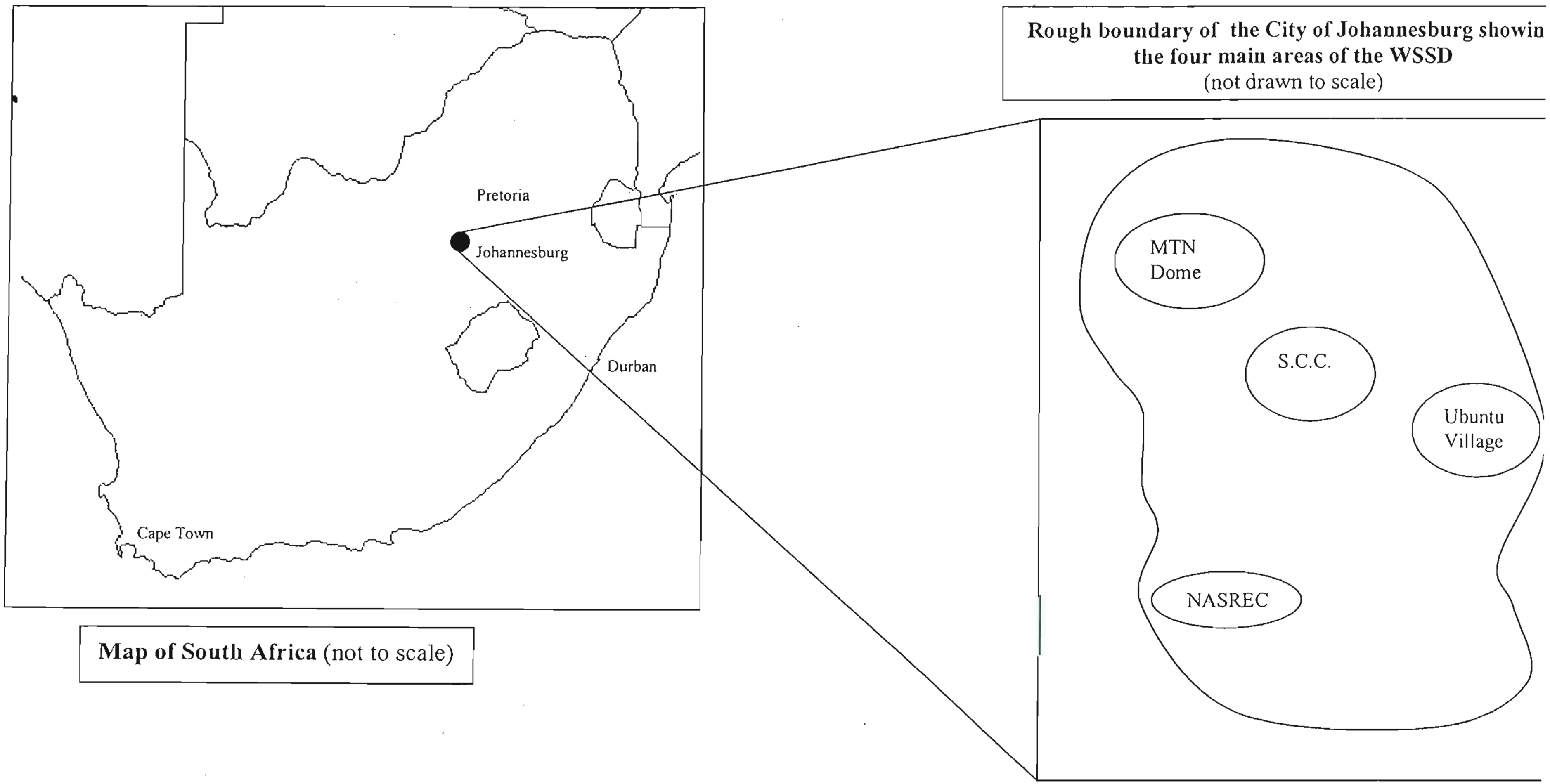
4.1 Impact Area

The WSSD was held in Johannesburg in Gauteng, South Africa. Gauteng is one of the nine provinces of South Africa and is the economic heartland of the country. Gauteng is approximately 1 701 000 ha (17 010 km^2) (Burger, 2003) in size and has a population of 8.8 million. The two main cities in Gauteng are Johannesburg and Pretoria. Pretoria is the administrative capital of South Africa and Johannesburg is often referred to as the economic capital. Johannesburg is approximately 1 465 km^2 in size and has a population of approximately 3.3 million (F. Mokgohloa, 2004, pers. comm.)[1].

The main events of the WSSD were held in different venues in various suburbs of Johannesburg. The Sandton Convention Centre (SCC) in the Sandton area was the venue for the main Summit, the NASREC (south of Johannesburg) was the venue for the NGO Global Peoples' Forum, the MTN Dome (located in Johannesburg north) was used as the Waterdome during the WSSD, and the Wanderers' Cricket Club was used for the Ubuntu Exhibition Village. (See map on p54). This meant that there was much commuting for delegates between the various venues and accommodation sites during the WSSD. Many parallel events were held concurrently over the rest of South Africa. While the environmental impact of the WSSD was applicable throughout South Africa, the concentration of activities took place in Johannesburg and hence the EF will be measured for Johannesburg with a focus on the area used for the main events.

4.2 Results of the EFA

The results of the EFA have been tabulated for each of the different subcomponents, *viz.* electricity, transport, water, waste and paper.



Map of South Africa (not to scale)

4.2.1 *Electricity Footprint*

The electricity footprint was calculated from the estimated carbon emissions from the electricity used in accommodation (Table 4.1) and conference venues (Table 4.2). The land area required to sequester the carbon produced from these processes is computed in Table 4.3.

Table 4.1: **Accommodation Electricity Use**

(a) Number of delegates	80 635[1]
(b) Number of days	10
(c) Energy consumption per room	31.23 kWh/participant/day[2]
Total electricity use [(a) x (b) x (c)] ÷ 1000	25 182.31 MWh
Emission factor	0.979 tons CO_2/MWh[2]
Resulting CO_2 emissions [(a) x (b) x (c) x Emission factor]	24 653.48 tons CO_2
SOURCE: [1]: DEAT (2003) [2]: Governing Body for WSSD (2002)	

Table 4.2: **Conference Venue Electricity Use**[1]

	kWh/day	**Days**	**kWh**	**MWh**
(a) The Sandton Convention Centre	25010	10	250 100	250.10
(b) The Wanderers Stadium (Ubuntu Village)	6252.5	10	62 525	62.53
(c) NASREC Expo Centre	18757.6	10	187 575	187.58
(d) Hilton Hotel	17507	10	175 070	175.07
(e) Nedcor	15006	10	150 060	150.06
(f) Waterdome	12505	10	125 050	125.05
Total conference electricity utilization [(a) + (b) + (c) + (d) + (e) + (f)			950 380	950.39
Emission Factor				0.979 tons CO_2/MWh[1]
Resulting CO_2 emissions				930.43 tons
SOURCE: 1: Governing Body for WSSD (2002)				

From Table 4.1, it is noted that the total electricity utilized in accommodating all the delegates, was calculated as the product of the total number of delegates (80 635), the duration of the WSSD (10 days), and the estimated average electricity consumed per participant per room (31.23 kWh/participant/day) (Governing Body for WSSD, 2002). The total CO_2 emissions from the electricity consumed in accommodating the 80 635 delegates was estimated as the product of the total electricity used and the appropriate emission factor, giving a value of 24 653.48 tons CO_2.

Similarly, the total CO_2 emissions from the electricity utilized at all the main conference venues for the period of the WSSD (Table 4.2) was estimated as the product of the total conference venue electricity utilized and the same emission factor, giving a total of 930.43 tons CO_2

Table 4.3: **Electricity Footprint**

(a) CO_2 emissions from Accommodation Electricity Use [1]	24 653.48 tons
(b) CO_2 emissions from Conference Venue Electricity Use[2]	930.43 tons
Total CO_2 emissions from electricity use [(a) + (b)]	25 583.91 tons
Total carbon (Total CO_2 emissions x 3/11)	6977.43 tons of carbon
Area conversion factor	75 tons of carbon fixation/ha[3]
Electricity footprint	**93.03 hectares**
SOURCE: 1: Table 4.1 2: Table 4.2 3: Edinburgh Centre for Carbon Management (2002)	

The total CO_2 emissions from the electricity utilized at all the main conference and accommodation venues was 25 533.91 tons, resulting in the emission of 6977.43 tons of carbon (Table 4.3). The resultant electricity footprint is the quotient of the total carbon from electricity generation and the area conversion factor which is equal to **93.03 ha** (Table 4.3).

The electricity footprint is not subject to geographical area constraints. It is a theoretical area of forest that would be needed to sequester the excess carbon that is being added to the atmosphere by the burning of fossil fuels to generate energy for all the electricity used during the WSSD.

4.2.2 *Transport footprint*

The transport footprint was estimated from the carbon emissions emanating from the international and domestic delegate air travel to the host city, as well as the delegate road travel between hotels and conference venues during the WSSD. The total CO_2 emissions from international air travel was calculated as the product of the total distance to Johannesburg from the seven main international destinations, *viz.* Africa (Central African Republic), Asia (Hong Kong), Australia (Sydney), Europe (London), Middle East (Tel Aviv), North America (Atlanta) and South America (Rio de Janeiro), the total number of passengers traveling from these destinations, and the emission factor of 0.35 kg CO_2 per passenger per km (Governing Body for WSSD, 2002). This value was then doubled to take into consideration the return trips and divided by 1000 since the total CO_2 emission is measured in tons while the emission factor is in kilograms (Table 4.4).

Table 4.4: Transportation: Delegate air travel to host city (international)[1]

Continent of Departure	**Distance to Johannesburg**	**Unit**	**Passengers**	**CO_2 Emissions**	**Unit**
Africa	3 521	km	4 500	11 091	tons
Asia	10 778	km	2 250	16 975	tons
Australia	11 078	km	4 500	34 896	tons
Europe	9 027	km	13 500	85 305	tons
Middle East	6 478	km	4 500	20 406	tons
North America	13 552	km	9 000	85 378	tons
South America	7 091	km	3 600	17 869	tons
Total CO_2				271 920	tons
Emission Factor	0.35 kg CO_2 per passenger per km				
Total Resulting CO_2 emissions				271 920 tons CO_2	
SOURCE: 1: Governing Body for WSSD (2002)					

The total CO_2 emissions from domestic air travel was calculated as the product of the total distance (in kilometres) to Johannesburg from the three main South African cities (Cape Town, Durban, Bloemfontein), the total number of passengers traveling from these destinations, and the emission factor of 0.35 kg CO_2 per passenger per km

(Governing Body for WSSD, 2002). This figure was then doubled to take into consideration the return trips and divided by 1000 as explained below (Table 4.5).

CO_2 emissions from delegate road travel between hotels and conference venues was calculated as the product of the average road distance traveled and the emission factor of 0.0485 kg CO_2 per passenger per km (Governing Body for WSSD, 2002). Again, the resulting CO_2 emissions were then divided by 1000 to convert this figure to tons CO_2 emitted from road transportation (Table 4.6).

The total CO_2 emissions from international delegate air travel was 271 920 tons (Table 4.4) as compared with 1 912 tons from domestic delegate air travel (Table 4.5).

Table 4.5: Transportation: Delegate air travel to host city (local)[1]

City of Departure	Distance to Johannesburg	Unit	Passengers	CO_2 Emissions	Unit
Cape Town	1 244	Km	1 575	1 372	tons
Durban	513	Km	1 260	452	tons
Bloemfontein	398	Km	315	88	tons
				1 912	
Emission Factor		0.35 kg CO_2 per passenger per km			
Resulting CO_2 emissions				1 912 tons CO_2	
SOURCE: 1: Governing Body for WSSD (2002)					

Table 4.6: Transportation: Delegate road travel between hotels and venues[1]

Description	Value	Unit
Average distance traveled per delegate/day	50	km/day
Number of delegates	80 635[2]	delegates
Number of days	10	days
Total distance traveled by all delegates during the 10 days		40 317 500 km
Emission factor	0.0485	kg CO_2 per passenger per km
Resulting CO_2 emissions	1 955.40	tons CO_2
SOURCE: 1: Governing Body for WSSD (2002) 2: DEAT (2003)		

The total CO_2 emissions from the delegate road travel between hotels and venue was 1955.40 tons (Table 4.6).

Table 4.7: Transport Footprint

(a) CO_2 emissions from delegate air travel to host city (international)[1]	271 920 tons CO_2
(b) CO_2 emissions from delegate air travel to host city (local)[2]	1 912 tons CO_2
(c) CO_2 emissions from delegate road travel between hotels and venues[3]	1 955.40 tons CO_2
Total CO_2 emissions from transportation [(a) + (b) + (c)]	275 787.4 tons CO_2
Total carbon (Total CO_2 emissions x 3/11)	75 214.75 tons of carbon
Area conversion factor	75 tons of carbon fixation/ha[4]
Transport footprint	**1002.86 hectares**
SOURCE: 1: Table 4.4 2: Table 4.5 3: Table 4.6 4: Edinburgh Centre for Carbon Management (2002)	

The land required to sequester the carbon produced from these processes is computed in Table 4.7. The total CO_2 emissions from the international and domestic air travel, as well as the delegate road travel between hotels and venues was 275 787.4 tons. The carbon emissions that emanated from the transport CO_2 was 75 214.75 tons. The resultant transport footprint is **1 002.86 ha** (Table 4.7).

4.2.3 *Water footprint*

The water footprint was estimated from the total water consumed during the WSSD for the generation of electricity in addition to the use of water at the six main conference venues and an estimate of delegate use at accommodation venues. The total electricity usage of 26 132 690.5 kWh during the WSSD was converted to water usage by multiplying by the conversion factor of 1.27 litres of water per kWh electricity generated (Eskom, 2003), yielding a total of 33.18 x 10^6 litres of water (Table 4.8).

Table 4.8: Water Footprint: Water consumed through the generation of electricity and at the main venues

Description	Value	Unit
(a) Accommodation electricity use	25 182 310.5[1]	kWh
(b) Conference venue electricity use	950 380[2]	kWh
Total electricity use [(a) + (b)]	26 132 690.5	kWh
Conversion factor	1.27[3]	litres water/kWh electricity generated
(c) Water from electricity use [(a) + (b)]	33 188 516.94	litres
(d) Water consumed by delegates (60*l* x 80635 x 10)	48 381 000.00	litres
Water Consumption of Conference Venues:		
NASREC Expo Centre	447 000[4]	litres
The Wanderers Stadium (Ubuntu Village)	1 750 000[4]	litres
The Sandton Convention Centre	784 107.53[5]	litres
Hilton Hotel	1 653 000[6]	litres
Nedcor, Sandton (average for WSSD from Aug & Sept. '02 bills)	2 092 623[7]	litres
Waterdome (average for WSSD from Aug. & Sept. '02 bills)	17 638.89[8]	litres
(e) Total water usage from conference venues	6 744 369.42	litres
Total Estimated Water Used During WSSD [(c) + (d) + (e)]	88 313 886.36	litres
Actual Johannesburg (Vaal Dam) catchment	7 030 700[9]	hectares
Total Johannesburg Water Consumption 2002	451 868 761 000[8]	litres
Proportion of water consumed at WSSD of total water usage in Johannesburg in 2002 (88 313 886.36/451 868 761 000)	0.0002	
Water Footprint: 0.0002 of actual (Vaal Dam) catchment	**1406.14**	**hectares**

SOURCE:
1: Table 4.1
2: Table 4.2
3: Eskom (2003)
4: Common Ground Consulting (2002)
5: (R. Flack-Davison, 2004, pers. comm.)
6: (B. Peebles, 2004, pers. comm.)
7: (I. Buchert, 2004, pers. comm.)
8: (C. Botha, 2004, pers. comm.)
9: http://www.dwaf.gov.za/orange/Vaal/vaaldam.htm

The amount of water consumed at the conference venues was estimated to be 6.74 x 10^6 litres and for personal use by delegates was estimated at 48.38 x 10^6 litres (Table 4.8). The total water consumed during the WSSD, *viz.* 88.31 x 10^6 litres was then expressed as a proportion of the total water usage in Johannesburg in 2002 (Table 4.3) in order to compute an area conversion factor, which was estimated to be 2.0 x 10^{-4}. The water footprint was then expressed as the product of the Vaal Dam catchment area and the area conversion factor, yielding a value of **1406.14 ha** (Table 4.8).

4.2.4 *Waste footprint*

Table 4.9: Waste Footprint

Description	Value	Unit
Resulting CO_2 emissions from waste[1]	4.49	tons CO_2
Total Carbon (4.49 x 3/11)	1.22	tons
Area conversion factor	75 tons of carbon fixation/ha[2]	
Forest area required to assimilate 1.22 tons of carbon	0.016	hectares
Total tons of waste at WSSD	1644.95[1]	tons
Total tons of waste in Johannesburg in 2002	1 244 444[3]	tons
Proportion of waste at WSSD of total waste disposal in Johannesburg in 2002 (1 644.95/1 244 444)	0.0013	
Total area of all landfill sites in Johannesburg	339[3]	hectares
Landfill required to assimilate waste (0.00132 x 339)	0.45	hectares
Waste Footprint (0.016 + 0.45)	**0.47**	**hectares**

SOURCE:
1: Governing Body for WSSD (2002)
2: Edinburgh Centre for Carbon Management (2002)
3: (M. Gericke, 2003, pers.comm.)[3]

The waste footprint was estimated from the total carbon emitted from the waste generated by the 80 635 delegates during the WSSD and the landfill area required for the disposal of this waste. The calculations are presented in Table 4.9.

From Table 4.9, the area of forest required to assimilate the carbon was estimated from the product of the total carbon emissions from waste (1.22 tons) and the area conversion factor (75 tons of carbon fixation/ha) giving a total of 0.016ha (Table 4.9).
The landfill space required to assimilate the waste generated at the WSSD was expressed as a proportion of the total waste disposal in Johannesburg in 2002 to give an area conversion factor of 0.00132 (Table 4.9). Therefore the landfill area required to assimilate WSSD waste is the product of the total area of all landfill sites in Johannesburg (339 ha) and the area conversion factor (0.00132), giving a total of 0.45 ha. Hence the waste footprint is the sum of the area of forest required to assimilate the carbon (0.016 ha) and the landfill area required to assimilate WSSD waste (0.45 ha), giving a total waste footprint of **0.47 ha** (Table 4.9).

4.2.5 *Paper Footprint*

Table 4.10: Paper Footprint

Description	**Value**	**Unit**
Total amount of paper at WSSD	25[1]	tons
Resulting CO_2 emissions	5.94[2]	tons
Total carbon from CO_2 emissions (x 3/11)	1.62	tons
Area conversion factor	75 tons of carbon fixation/ha[3]	
Forest area required to assimilate carbon	0.022	hectares
Area conversion factor	1t = 1,8m^3 wood; 2,3m^3/ha/yr[4]	
Area of forest required for paper production	19.57	hectares
Paper footprint (0.022 + 19.57)	**19.60**	**hectares**
SOURCE: 1: IUCN (2003) 2: Governing Body of the WSSD (2003) 3: Edinburgh Centre for Carbon Management (2002) 4: Wackernagel and Rees (1996)		

The paper footprint was estimated from the total carbon emitted from the paper produced that was used by the 80 635 delegates during the WSSD as well as the ha of forests required to produced the wood needed for all the paper used at the WSSD. The land required to sequester the carbon produced from these processes and the forest required to provide the trees for the paper, is computed in Table 4.10 above.

The forest area required to assimilate the carbon from paper production is the quotient of the total carbon emitted (1.62 tons) and the area conversion factor of 75 tons of carbon fixation/ha, to give 0.022 ha. The forest area required for the wood to produce the paper used at the WSSD was the product of the total amount of paper used (25 tons) and the area conversion factor for paper production (1ton = $1.8m^3$ wood, $2.3m^3$/ha/yr), giving a forest area of 19.57 ha (Table 4.10).

The paper footprint is the sum of the forest area required to assimilate carbon (0.22 ha) and the area of forest required for paper production (19.57 ha), giving a total paper footprint of **19.60 ha** (Table 4.10).

4.2.6 *Ecological Footprint of the WSSD*

The total EF of the WSSD, based on the five sub-components discussed in the previous section, is calculated by summing the electricity, transport, water, waste and paper footprints and is presented in Table 4.11.

Table 4.11: Ecological Footprint of the WSSD

Footprint Components		Percentage of total
Electricity Footprint	93.03 ha[1]	3.70
Transport Footprint	1002.86 ha[2]	39.76
Water Footprint	1406.14 ha[3]	55.75
Waste Footprint	0.45 ha[4]	0.02
Paper Footprint	19.60 ha[5]	0.77
TOTAL ECOLOGICAL FOOTPRINT	**2 522.08 ha**	
Per capita footprint (EF/N)	0.03 ha	
Johannesburg	146 500 ha[6]	
Gauteng Province	1 701 000 ha[7]	
South Africa	121 909 000 ha[7]	
Built footprint	0.11 ha/person[8]	
Per capita EF of South Africa	4.02 ha[8]	
Per capita world EF	2.28 ha[8]	
SOURCE: 1: Table 4.3 2: Table 4.7 3: Table 4.8 4: Table 4.9 5: Table 4.10 6: (F. Mokgohloa, 2004, pers. comm.) 7: Burger, D (2003) 8: WWF (2002)		

The total EF of the WSSD was estimated at **2 522.08 ha**, giving a per capita footprint of **0.03 ha** (Table 4.11).

4.3 Discussion of Results

The total footprint of the WSSD as estimated in this study is made up of the electricity, transport, water, waste and paper EFs.

Electricity footprint

The electricity footprint was estimated to be 93.03 ha and comprises 3.70% of the total EF of the WSSD. The electricity component was based on the assumption that electricity generation is coal-based, which is a valid assumption for South Africa (Eskom, 2003). The value of 93.03 ha implies that 93.03 ha of forest land are needed to absorb the carbon emissions from fossil fuel (coal in particular) used in generating electricity during the WSSD.

The electricity footprint is a fairly small percentage (less than 1%) of the total EF of the WSSD. The main source of CO_2 for electricity generation during the WSSD came from accommodation electricity use (24 653.48 tons) and less from conference venues (930.43 tons). Accommodation electricity use contributed 96.37% to the electricity footprint (Table 4.3). A reduction in energy consumption during the conference by using energy saving devices would not impact greatly on the total EF. Moreover, it would be difficult to control accommodation electricity use as delegates stayed at numerous and diverse venues, including private homes. The electricity footprint is directly influenced by the number of delegates and the ten days over which the WSSD was held. A reduction in the number of delegates and days of the WSSD would reduce the footprint. For example a 50% reduction in the number of delegates or in the number of days of the WSSD, would have halved the electricity footprint.

Transport Footprint

The transport footprint was dominated by international air travel, which accounted for 98.6% of CO_2 emissions. Both local and international air travel contributed substantially greater amounts of CO_2 due to the large volumes of jet fuel consumed during flights and hence the relatively higher emission factor. Road transport was used extensively during the WSSD to transfer delegates between the various conference venues and accommodation facilities. A total distance in excess of 40 million kilometres was covered during the ten day period, yet due to the lower emission factor (0.0485 kg CO_2 per passenger per km), the contribution to total CO_2 emissions was only 0.71%.

The transport footprint was the second dominant sub-component of the five footprints and represented 39.76% of the total EF of the WSSD, approximating 1 002.86 ha. This value is equivalent to a theoretical area of forest that would be needed to sequester the excess carbon that is being added to the atmosphere by the carbon emissions from air and ground transportation during the WSSD. In view of the foregoing, efforts at reducing the EF must focus on this component.

Although the computation of the transport footprint was based entirely on CO_2 emissions per kilometer traveled, it is significant that attempts were made to limit vehicular emissions during the WSSD. An initiative termed, *Greening of the WSSD* (Common Ground Consulting, 2002) co-ordinated by the IUCN focused in particular on limiting emissions from buses. Diesel Particulate Filters (DPFs) were fitted to a number of buses in order to reduce particulate emissions and associated smoke by up to 99%. After the WSSD, the DPFs were left on the buses, which are now used for public transportation, as an ongoing local benefit. All new vehicles used during the summit were Euro 2001 compliant and used 134A gas (CFC free) in their air conditioners. Euro 2001 is the European Community Directive 70/220/EC and its subsequent modifications that control the problem of exhaust gases generated by motor vehicles and measures to be taken against air pollution by emissions from motor vehicles (http://www.as-sl.com/eng/approvals/homolog.htm). Further, vehicles were checked and tuned once per week to minimise oil leaks and excessive diesel smoke. Vehicle idling was kept to a minimum to control fuel wastage and pollution through the education of drivers (Common Ground Consulting, 2002).

It is significant, however, that despite local attempts to "green" conferences, the bulk of the impact stems from international air travel. The ease of international travel and the fact that, for most delegates, the costs are met by employers or sponsors, means that conference travel is increasing in frequency. One of the main consequences of this is the impact on global warming and climate change. Global emissions of CO_2 from air travel are increasing rapidly. The Intergovernmental Panel on Climate Change (IPCC) predicted that, by the year 2050, annual aircraft emissions will have exceeded a billion tons of greenhouse gas (GHG) (Reay, 2003). Attempts to reduce the transport footprint of conferences must focus on reducing international air travel. This can be achieved by reviewing the impact of hosting of international conferences. Alternatives to reduce air travel such as teleconferences, hosting conferences where the largest numbers of delegates reside, *inter alia*, must be vigorously pursued.

Water Footprint

The water footprint was the largest of all the sub-components and represented 55.75% of the total EF of the WSSD. The water footprint of 1 406.14 ha means that a catchment of this size was required to supply the water needs of the WSSD. Water usage was made up not only of water consumption of conference venues (approximately 6.7 million litres), but also resulted from electricity usage (20.13 million litres) and estimated use at accommodation venues (Table 4.8). Fossil fuel power stations consume vast quantities of water and as such electricity usage makes a significant contribution to the water footprint. For example, in 2002, Eskom power stations used 251 611 million litres of water (Eskom, 2003). Whilst it was earlier argued, under the discussion of the electricity footprint, that electricity conservation measures would make a negligible impact on the overall EF, it is evident, at this juncture, that conserving electricity during the summit would have a major impact on the water footprint and hence the total EF. Furthermore, greater reliance on renewable energy sources rather than fossil fuel power stations would likewise reduce the water footprint. Pursuing this statement, it could be argued that it is more beneficial (sustainable) to host large events in countries where renewable energy makes up a large proportion of their energy mix in order to reduce the size of the EF. Notwithstanding, the contributions of CO_2 from international air travel to the EF, would still have to be considered. Furthermore, countries with renewable energy sources are mainly developed countries. Hosting large events in only these countries will do little to boost the economies of developing countries which generally have minimal to no renewable energy sources.

Actual water consumption at the conference and accommodation venues represented 0.01% of the total water usage of Johannesburg in 2002 (Table 4.8), with consumption at accommodation venues being the dominant contributor to overall water use during the WSSD. Although the WSSD was held for only ten days, it is significant that nearly 0.01% of Johannesburg's annual water usage was consumed by a single event. It is evident that large conferences such as the WSSD are major consumers of water. This is cause for concern especially in a country like South Africa where water is a scarce resource. Reducing the EF of an event such as this must therefore focus on innovative and effective ways of reducing water consumption.

Water is scarce and conservation and efficient management are essential in South Africa. Taking into consideration the impact that water consumption at the WSSD would have on South Africa's water resources, attempts were made during the WSSD to reduce water consumption. Water management and conservation was an integral part of the "*Greening the WSSD*" initiative (Common Ground Consulting, 2002). Ahead of the WSSD, a project was launched to ensure that hotels, restaurants and conference venues in Gauteng were managing water efficiently and helping to conserve the province's limited resources. Some of these water management initiatives included the improvement of plumbing fixtures and technology, repairing leaks in hotels, conference venues and restaurants; reducing effluent discharge; and running water conservation awareness campaign for staff and delegates (Common Ground Consulting 2002).

Waste footprint

The footprint component from waste was 0.47 ha. This represented 0.02% of the total EF of the WSSD. Of this, 0.016 ha of forests were required to sequestrate the carbon generated from the waste disposal and approximately 0.45 ha of landfill was required for the disposal of the waste generated at the WSSD.

According to Common Ground Consulting (2002), some of the waste management plans implemented during the WSSD, included waste separation with bins that separated wet and dry waste. Wet waste, including food, was collected and taken to composting facilities where it was combined with garden refuse. Dry waste was moved to a transfer station where it was sorted and recycled. This created a number of job opportunities, as people were given concessions to sort the material, which they sold to recycling companies. Delegates to the WSSD and the 5 000 volunteers involved were made aware of the need to separate their waste.

Two other initiatives, *viz.* the South African Breweries (SAB) and Coca-Cola projects for the WSSD, also contributed to the reduction in waste disposal. SAB initiated a project in which local entrepreneurs formed a company which reused glass bottles to make pitchers and drinking glasses. The glasses were sold at a stand at the Ubuntu Village as a showcasing initiative. This reduced the amount of glass which needed to be recycled and contributed to job creation. Of the 13 272 bottles of beer used, 4 400 (33.2%) were converted into drinking glasses. The Coca-Cola Bottling Company committed to supplying beverages only in cans which could be recycled. However, the mineral water could only be supplied in bottles which are normally not recycled. To counter this, the company facilitated the assembling of local entrepreneurs who collected all bottles which were then spun into fabric and used for the lanyards for conference delegates' badges, once again reducing the amount of waste to landfill. Non-recyclable material was sent to a landfill, but was only a small portion of the entire waste load created during the WSSD (Common Ground Consulting, 2002).

Paper Footprint

The paper footprint for the WSSD was 19.60 ha, which was 0.78% of the total EF of the WSSD. As such the paper footprint makes a negligible contribution to the total EF and implies that conservation measures to reduce the size of the paper footprint will have little impact on the overall EF. Approximately 25 tons of paper was used during the WSSD, producing approximately 8.11 tons of carbon that required 0.11 ha of forest to sequester the carbon. A further 19.50 ha of trees were required to provide the wood for the paper needed at the WSSD.

EF of the WSSD

This first EFA of the WSSD suggests that the EF was 2 522.08 ha. This is equivalent to an area of 1.72% of Johannesburg and 0.15% of Gauteng for the supply of resources and the absorption of its wastes associated with the WSSD. This is significant as the WSSD was confined to a small suburb in Johannesburg, yet had a footprint that required the equivalent of $1/58^{th}$ the area of the city. However, the EF of the WSSD comprises less than 0.01% of the total area of South Africa, implying that all the materials consumed and waste generated could be appropriated within South Africa, and specifically within Gauteng and Johannesburg.

The water footprint contributed the most to the EF of the WSSD, comprising 55.75% of the EF, while the waste footprint contributed the least (0.02%) (Table 4.11). This computation of the EF clearly demonstrates which sub-components require the most urgent attention to reduce the EF and hence move towards strong sustainability.

The per capita EF of the WSSD was 0.03 ha compared with South Africa's per capita EF of 4.02 ha. This implies that each of the delegates required a land area of $300m^2$ for the production of goods and the absorption of waste to meet their needs. Assuming that the per capita EF is applicable for the average Johannesburg resident, it is evident that the WSSD increased the EF by less than 1%.

While comparisons between a short term event (such as the WSSD) and annualized figures may not be valid, the EF clearly demonstrates the patterns of consumption in a metropolitan metabolism (use of resources and generation of waste in an urban area) associated with a large conference such as the WSSD. The WSSD inflated Johannesburg's 2002 metabolism, but not by very much. The delegates would have consumed resources and produced wastes elsewhere on the planet in their home cities, had they not attended the WSSD. Apart from the fuel needed to travel to Johannesburg, the impact on global systems may also have been insignificant. In the bigger global and metropolitan picture of resource consumption and waste generation, the impact of the WSSD was minimal. It suggests that such events do not constitute significant points of intervention for the reductions of EFs and that it is changes to the day to day patterns of consumption of the local community that are key to change.

The strong approach to sustainability considers individual ecological impacts associated with consumption within the context of global carrying capacity. To be strongly sustainable, then, delegate members would have to have an environmental impact that on average is the same or less than the global amount of ecologically productive land (nature) available on a per global citizen basis. According to the Worldwide Fund for Nature (WWF), there are roughly 2.28 ha of annually renewable ecologically productive land/services available in the world on a per capita basis (WWF, 2002). However, because the data being analysed in this study do not include food, arable and pasture land, comparisons with the WWF figure are not valid. The WWF figures takes into consideration the contributions of food, arable and pasture land in the calculation of the ecologically productive land/services available in the world. Furthermore, the world EF of 2.28 ha is an annual figure, whereas the EF for the WSSD was for a once-off ten day event only.

From the weak version of sustainability, to be sustainable, the average WSSD delegate would have required a (net) EF equal to or less than the ecological limits of South Africa on a per person basis for a ten day period. However, in the absence of benchmark EFs for short term events such as the WSSD, comparisons with South Africa's annual *per capita* EF of 4.02 ha/person are likely to be invalid. Notwithstanding, it should be remembered that the research in this paper only included a portion of the EF of the WSSD. It is possible that, with the addition of other factors such as food, building material, paved space, etc., the EF of the WSSD might not even be considered sustainable from a weak perspective.

In summary, the main findings are that from an ideal and strong conceptualization of sustainability, since the consumption of natural services and waste output are greater than what is naturally provided and absorbed, in the immediate area of the WSSD, *viz.* main venues for the WSSD, that demand outpaced supply. Thus there is a net reduction in the amount of natural capital that can be used to provide natural services in the future for the residents of Johannesburg. This unsustainable pattern is part of the global consumption gap identified earlier. From the weak approach to sustainability the WSSD may be sustainable, though the inclusion of other environmentally intensive consumption factors could counter these findings.

CHAPTER FIVE

CONCLUSION

5.1 Summary of Results

The total EF of the WSSD, based on the five sub-components of electricity, transport, water, waste and paper was 2 522.08 ha, of which 55.75% comprised the water footprint. The transport footprint appropriated 1002.86 ha, amounting to 39.76% of the total EF of the WSSD. The electricity footprint appropriated 93.03 ha of forest and constituted only 3.70% of the EF of the WSSD. Waste and paper footprints were equivalent to 0.47 ha and 19.60 ha of forests and landfill area respectively, constituting less than 1% of the total EF of the WSSD.

The results imply that for the production of goods and assimilation of wastes for the WSSD, an area equivalent to 1.72% of Johannesburg and 0.15% of Gauteng was required. Based on a weak approach to sustainability, it could be argued that the WSSD was sustainable. However, it must be emphasized that this study only included a portion of the WSSD's total EF. It is possible that with the addition of other factors such as food, building materials, paved-space and resources consumed in the preparation and logistics associated with hosting the WSSD in Johannesburg, the EF of the WSSD and similar other large events, would not be considered sustainable from a weak perspective. From a strong or ideal approach to sustainability there are many opportunities for large events such as conferences to move towards sustainability by implementing actions on the most dominant sub-component footprints in an attempt to reduce the overall EF.

The EF of the WSSD is lower than the South African or other developed country footprints. This is partially dependent on the underestimation of the EF for a number of reasons. First, only a select number of consumption categories are measured in this assessment. Second, the assumptions made due to incomplete data sets intentionally err on the side of underestimation of the EF. Third, the CO_2 assimilation method results in the smallest EF attributable to fossil fuel consumption (Wackernagel and Rees, 1996). Moreover using the area conversion factor of 75 tons per ha (Edinburgh Centre for Carbon Management, 2002), rather than the one ha per 1.8 tons of carbon emitted each year of Wackernagel and Rees (1996), results in a substantially lower electricity EF.

Attempting to extrapolate the ten day figure to an annual figure for South Africa is invalid according to Rees (2004, pers. comm.)[1]. Rees (2004, pers. comm.) [1] argues that the EF of a specified population or economic activity is normally defined as the area of land and water ecosystems required on a continuous basis by that population (or activity) to produce the resources that the population/activity consumes and to assimilate its wastes. This implies that the eco-footprint normally estimates the on-going demand for ecosystems services by a permanent population (for example the city of London) or activity (for example fish-farming) recognizing that there will be fluctuations over time with changing life-styles, incomes and technology. The situation is different for a short-term event. There is no validity in estimating the annualized eco-footprint of a ten-day event. The conference is over and while the carbon is out there being circulated and partly assimilated all over the world, there is no on-going demand for assimilative services. For the WSSD, the issue is determining the area of more or less stable carbon sink that would be required to contain all the carbon released by the conference. The global carbon eco-footprint exceeds the area of available carbon sinks which is why carbon (as CO_2) is accumulating in the atmosphere (Rees, 2004, pers. comm.)[1]. With these factors in mind, a comparison of EF of the WSSD with South Africa's regional footprint estimates is invalid.

Venetoulis (2001) maintains that the presentation of an EF far greater than the geographical footprint is not surprising for a conference that is overtly a net importer of consumption items and exporter of wastes. In an era of dynamic global markets, the footprint does not relate to a specific area in the immediate vicinity of the WSSD only. Importation of consumption items means that the footprint of the WSSD impacts on the provincial, national and global communities. EFA allows the location and extent of impacts on consumption to be demonstrated (Flint, 2001). More importantly it relates consumption patterns of a conference to specific biophysical impacts, reinforcing the basic assumption that for a conference such as the WSSD to be sustainable, the EF should be reduced, through a reduction in the use of resources and generation of wastes.

It is the individual components of the EF that offer the greatest benefit for sustainability management. EFA allows consumption to be viewed in two related ways. First, it is possible to determine where the greatest impact is occurring.

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In the EFA for the WSSD, water catchment appropriation is the most significant part of the footprint impact. While this is likely to represent bias based in the chosen consumption categories and the ready availability of water data, it clearly indicates the impact on scarce water resources. Second, is the ability to rank-order consumption based on contribution to the EF. The greatest benefits in terms of sustainability are likely if increased effort is directed at reducing the footprint of those consumption items contributing the most to the EF.

It is likely that the ecological deficit revealed in the EFA of the WSSD, will be replicated in all large events. EFA clearly presents a challenge for conference sustainability. Venetoulis (2001) asserts that by offering ways of identifying problem areas, assessing outcomes, modeling futures and tracking progress, EFA offers an opportunity to take sustainability from policy to implementation.

EFA clearly confronts economic and social values which reinforce over consumption by demonstrating their unsustainability. The simple goal of a reduced footprint for the WSSD and other such large events, guarantees a movement towards genuine sustainability.

In each of the sub-components comprising the EF, it is recognized that consumption or waste cannot be measured with 100% accuracy. One good example is the water consumption during the WSSD. Delegates stayed at various different venues during the ten days of the WSSD and an estimated average water consumption was used. Nor can the subtleties and full meaning of the impacts on nature (including humans) from conferences be captured in the type of research carried out in EFA (Venetoulis, 2001). For example delegates' pre- and post-conference ecotourism impact such as increased number of visitors to parks, climbing mountains, visits to the beach, etc. was not considered in this study.

The ecological focus and area based measure that the footprint analysis provides, does, however, help to reveal some of the 'hidden' ecological costs of consumption that cannot be captured using some conventional approaches and analysis techniques, such as cost benefit analysis and environmental impact assessment reports (Venetoulis, 2001). As useful as these other approaches can be, they do not provide a way in which ecologically intensive consumption can be assessed from a sustainability perspective.

Though clearly not providing a perfect measure of the total impact stemming from human activity, EFA can be used to identify 'nature intensive' consumption patterns and thereby help inform action aimed at changing the underlying causes.

5.2 Recommendations

The pursuit of strong sustainability and hence reduced environmental degradation relies on a reduced footprint for countries, regions, cities, events and activities.

Large conferences such as the WSSD use vast amounts of resources. The contribution of international conferences to environmental degradation is undeniable as demonstrated in this first estimation of the EF of the WSSD. Greenhouse gas (GHG) emissions from electricity generation, air travel and waste disposal as well as water consumption, and large scale waste generation are just some of the aspects contributing to environmental impacts of large events.

With most international conferences such as the WSSD, having hundreds if not thousands of participants, and the bulk of these usually traveling by air, conference travel is an area where significant reductions in air-travel related GHG emissions could be made. Indeed, through efforts to cut their own air-travel-related GHG emissions, the scientific community can set an example to the wider world, not least the international business community (Reay, 2003).

To ensure and promote the strong sustainability of events such as the WSSD, or any other policy, programme, project or activity in South Africa, it is essential that the principles of the NEMA (Act No. 107 of 1998), are upheld and vigorously pursued. Herein lie guidelines to review (and amend) the manner in which large events are hosted, as these are the principles for sustainable development, as documented in South African law.

Furthermore, Section 28 (1) of the NEMA (Act No. 107 of 1998) states, *inter alia*:

> "*Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be*

avoided or stopped, to minimise and rectify such pollution or degradation of the environment".

This places a legal responsibility on event organizers to put in place environmental management programmes (EMP), which could be considered as a reasonable measure, to reduce the impact of events. However, to develop an effective EMP, an assessment of the impacts of the event is the starting point. This can be done using EFA. EFA could be pivotal in any meaningful 'event greening' initiatives.

As an environmental conference itself, the outcomes of the WSSD must reflect sustainability into the future. One of the ways this can be achieved is by ensuring that all major events address sustainability issues and attempt to reduce EFs. There are many strategies to reduce the EF of conferences. Some actions were put in place during the WSSD, as part of the "*Greening of the Summit*" (Common Ground Consulting, 2002). However, more innovative and concrete actions must be taken to seriously address conference level environmental impacts. As this research has indicated, conferences contribute to environmental degradation, due mainly to their size and frequency. The main issue will be to assess the manner, e.g. frequency, location in which international conferences are held and the value added, measured against their contribution to environmental degradation on the planet. There is a need to reduce the number of international conferences to minimize their overall contribution to environmental degradation.

One of the first actions that could be taken for events already scheduled, will be to calculate the impacts of all large events before they occur, especially international events such as conferences, sporting events and rock concerts, through the use of a tool such as EFA. With countries required to put in bids to host many international events, e.g. the 2010 Soccer World Cup, part of the bid document should include the EF of the event. Bids to host international events usually include considerable details and data on, *inter alia*, the resources required, number of delegates. It should therefore be relatively easy to compute a first estimate of the EF of such events. If the EF is unacceptably high, or more than the country EF, then there should be a review of the decision on the hosting of the event.

However, if other factors promote the hosting of the event, such as economic incentives, as in the case of the 2010 Soccer World Cup in South Africa, then the early approximation of the EF will add to the sustainability of the event. Once the EF is known, it is then easier to reduce the EF through various strategies. While it may sometimes be difficult to minimize, for example the international air travel, due to the prerequisite number of delegates for some events, the EF could be reduced by focusing on other more manageable footprints, such as water and electricity footprints by reducing use of these consumption items to offset the large transport EFs.

The methodology for calculating EF according to Rees (2001) is

$$EF = \frac{\text{total consumption of item } (i) \text{ in kilograms}}{\text{area conversion factor}}$$

The area conversion factor is regarded as constant over a period of time. However, the area conversions factors are likely to be reduced due to the declining regenerative and assimilate capacity of nature stemming from the steady reduction of biodiversity and the threat to the integrity of ecosystems around the world. From the equation it is apparent that the EF is directly proportional to the total consumption of an item. Hence a reduced EF can be obtained by reducing the total consumption of item (*i*) in kilograms. An acceptable level EF can be estimated, and conference planners can then ensure that for the sustainability of the event, the EF remains within acceptable limits by reducing the total consumption, e.g. numbers of delegates, or reducing GHG emissions, or controlling waste generation and disposal, reducing water consumption, etc.

The evidence that human-induced increases in atmospheric carbon dioxide are already detectable has spurred international concern reflected at the Kyoto conference in 1998. The corollary of this evidence is that the natural global systems for carbon sequestration are not handling the human contributions fast enough. Only about half of the carbon we generate through burning fossil fuels can be absorbed in the oceans and existing terrestrial sinks (Suplee, 1998). The most effective way to sequester the excess carbon would be to add appropriate amounts of new forest, because, on a global scale, forests are the largest absorbers of CO_2. Energy footprint analysis shows that the amount of new forest needed is unrealistically huge, and thus there seems to be no satisfactory mitigation available to limit the buildup of CO_2 in the atmosphere. However, the reduction in the electricity footprint could be achieved by replacing coal-fired power stations with sustainable energy sources, such as wind or solar wherever economically feasible. The total emissions could also be managed by consumers. Consumers (and delegates at conferences) need to be educated on the wise and conservative use of electricity in South Africa, as it is fossil-fuel based. At the WSSD, the electricity footprint could have been further reduced if delegates were made aware of the implications of their electricity use and acted accordingly to reduce their electricity consumption. For the WSSD, 93.03 ha of forest should be planted to offset the carbon emissions that emanated from the WSSD electricity usage.

A conference level EFA clearly demonstrates the extent of impacts and provides guidance on where effort to achieve sustainability is best focused. Integration of EFA into regular sustainability measurement routines adds to the sustainability assessment process (Flint, 2001). The possibility exists for using EFA as a comparative tool for assessment of sustainability between similar events. Repeating the EF process either as a total or as a partial calculation will undoubtedly improve the data sets on which the footprint is based and hence the accuracy of the footprint estimates. There is also potential for its use as an education tool, as demonstrated by the current availability of online EF calculations (Flint, 2001).

The conference model of EFA presents a cumulative assessment of the complex energy and matter through-puts and cycles supporting conferences, together with human interrelationships and impacts. It breaks down barriers between the different service providers who are key to EFA, by requiring multidisciplinary input of data and information and presenting a common goal for sustainability. Similarly, sustainable solutions require multi-disciplinary consultation and action.

Reduction of the EF of events, and consequent reduction in environmental degradation will only be effective if there is widespread awareness of and education about the EF of countries, regions, cities, events and activities. Event organizers must educate delegates on their contribution to the EF of an event, its consequences and provide guidelines on how delegates could minimize their contribution to the EF. Creating an awareness of the impact of such large events is likely to initiate actions to reduce impacts. Widespread presentation of the EF before an event such as the WSSD or the 2010 Soccer World Cup, will provide a comprehensive understanding of the impacts associated with such large events such as air travel, commuting, electricity usage, waste disposal and paper use, etc. Understanding can facilitate a change in attitude that is essential for a sustainable outcome.

The profit motive drives the need to have more tourists, more sports fans and more delegates to large events. However, this attitude needs to be reviewed. Event organizers must consider balancing short term financial profits with long-term environmental degradation and the associated costs. There is a serious need for conference planners to review the number of delegates attending international conferences. The use of improved communication technologies facilitates the use of video conferencing, and/or e-mail/internet conferencing. This will substantially reduce the GHG emissions from international air travel. The International Virtual Conference on Genomics and Bioinfomatics used Access Grid to host a meeting attended by several hundred delegates (Raey, 2003). Access Grid has an advantage over video conferencing as it enhances the interaction between delegates by allowing all participants to see and hear one another while at the same time being able to view the main presentation. The saving from this virtual conference amounted to about 900 tons of GHG (Raey, 2003).

In situations where the number of delegates cannot be reduced, the EF could be reduced by managing other resource consumption items better. Water consumption constituted 99% of the EF of the WSSD. A strategy to manage water consumption much better at large conferences such as the WSSD will result in a reduced EF. Such water management strategies should involve a range of options, from awareness to improved technology and financial incentives.

The electricity EF of the WSSD highlights the impacts of fossil-fuel power generation. Energy sourced from the sun and wind through photovoltaic and windmill applications, despite having efficiencies less than fossil fuel produced electricity, does not necessarily require ecologically productive land for carbon assimilation. The use of renewable resource-based heating and cooling in conference venues will demonstrate a trend towards the use of sustainable energy systems. Applications of sustainable energy technology to existing conference facilities would demonstrate a stronger commitment to sustainability and benchmark energy consumption reductions.

The contribution of air travel to the EF of the WSSD and the transport EF was significant. The EF of the WSSD identifies a need to reduce this transportation component of conference footprints. Serious consideration must be given to the number of delegates traveling to conferences, especially those who travel by air. Management strategies aimed at reducing vehicle usage during conferences have the greatest chance of reducing the transport component of the overall footprint. Some of the strategies that could be implemented include the use of more efficient vehicles, the better planning of trips, car pooling and a better strategy to reduce distances between conference venues and accommodation facilities. Environmental conferences could be an ideal opportunity to use solar panel, electric driven or biogas vehicles. However, this could be applied to all large events that require mass transit.

Where GHG emissions are unavoidable, carbon trading initiatives could be put in place to offset the GHG emissions, especially of those delegates who contribute the most to CO_2 emissions. This should be incorporated into the conference registration fees, and not be an option for delegates. This was done, to a certain extent, at the WSSD. Delegates, international companies and individuals were invited to purchase Climate Legacy Certificates. Funds raised were held by a Trust Fund and then redistributed to sustainable energy projects across South Africa, which delivered CO_2 reductions. The resulting reduction in greenhouse gasses from these projects compensated for emissions caused by the WSSD and helped improve the quality of the environment in poor and rural communities. The Johannesburg Climate Legacy project was the first time an attempt was made to offset the gas emissions from a conference as large as the WSSD (Common Ground Consulting, 2002).

Alternative modes of transport, such as rail and bus for travel to conference venues should be promoted, especially for those traveling from within a country. Vehicles for travel during the conference should be those with low GHG emissions, such as electric or biogas vehicles. The entire conference programme and range of activities should be reviewed to reduce traveling of delegates between different conference venues and accommodation facilities.

More than the applicability of EF for large events such as the WSSD, EF has greater implications for sustainability. In view of this, it is recommended that EFA be seriously considered as an essential tool to move towards the strong sustainability of countries, regions, cities, projects and events. It must be promoted both in governmental and education sectors. Universities should consider including EFA in their environmental management and environmental science curricula. Further studies, research and case studies are essential to improve the understanding of EF and its application.

From a government perspective, large events, especially international conferences, sporting events and rock concerts with more than 1000 delegates should be listed as one of the activities in Schedule 1: "The Identification Under Section 21 Of Activities Which May Have A Substantial Detrimental Effect On The Environment" of Regulations 1182 of the Environment Conservation Act, 1989 (Act No. 73 Of 1989). This could pave the way for assessments (for example through EFA) to be undertaken of such events and thereby contribute to reducing their potential environmental impacts and enhancing their sustainability.

Although the results and recommendations of this study were drawn primarily from an event with an environmental content, the scope of this study goes beyond environmental events. It is aimed at hosts and organizers of all large-scale events, such as conferences, exhibitions, sporting, music and cultural events. Relevant events may involve the use or modification of existing venues or the construction of permanent and/or temporary structures. The environmental impact activities associated with large events, such as accreditation, transportation, accommodation, catering, communication, merchandising, medical and security services, and waste management, can be assessed with EFA.
As the basic principles of EFA can be applied to any decision or activity at any scale, organisations and individuals may also find value in the results of this study. Through the proposal of EF as a sustainability tool, this dissertation ultimately seeks to influence individual and collective behaviour to leave a legacy of environmental best practice and thereby ensure a strong sustainability ethic of large events.

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APPENDIX 1: List of major national and international events (with delegates of 1 000 and more) held at the ICC, Durban, SA. (http://www.icc.co.za)

DATE	EVENT	NO. OF DELEGATES
21/08/1997	IKUSASA CONSAS	1000
01/11/1997	National Conference On Small Business	3000
30/04/1998	1998 INDABA Show (Satour)	2000
19/06/1998	National Secretaries Convention	1000
09/07/1998	5th International Convention For Global Organisation Of People Of Indian Origin	1200
15/08/1998	International Ornithological Congress	2000
23/08/1998	Conference On The Non Aligned Movement	3000
06/09/1998	SADTU National Congress	1200
09/10/1998	World Airline Entertainment Association	1500
27/11/1998	The Getaway Show 1998	EXHIB
11/02/1999	Spar/Nedbank World Flower Show	2000
21/02/1999	Computer/Bexa Fair	EXHIB
23/03/1999	3rd International Clothing, Textile & Fashion Week Of S.A	EXHIB
31/03/1999	Kenneth Copeland Victory Campaign	4000
11/04/1999	Mind Power Seminar	1000
13/04/1999	SACIE Conference Exhibition	EXHIB
01/05/1999	1999 INDABA	2000
11/06/1999	World Congress On Trauma	3000
29/06/1999	Labour Law Conference	1200
06/07/1999	Franchise Association Of SA	5000
01/08/1999	15th INQUA Congress	1500
12/08/1999	Foundation Elan Vital Conference	1200
28/08/1999	A Night Of 100 Stars	1680
18/09/1999	International Society Of Haematology Conference	1500

24/09/1999	1999 Massed Choir Festival	2500
09/10/1999	9th Int'l Anti Corruption Conference	1500
01/11/1999	ICEM (International Mineworkers Union)	1000
12/11/1999	1999 Commonwealth Heads Of Government Meeting	1000
12/11/1999	1999 Commonwealth Heads Of Government Meeting	1000
17/11/1999	Getaway Show 1999	32 000
27/11/1999	Old Mutual National Choir Festival	3500
05/12/1999	1999 Union Of African Population Studies	1000
19/12/1999	KZN Fire Conference	5000
31/12/1999	New Year's Eve 1999 Gala Dinner	2500
05-12/03/2000	Computer/Bexa Fair	10 000
03-07/04/2000	2000 International Confederation Of Free Trade Unions Congress	1 200
17-26/04/2000	Aids Awareness Training	1000
21/04/2000	Diakonia Easter Church Service	3312
22/04/2000	Russian State Cossack Dance	1200
30/04/2000	INDABA 2000	2500
26-27/05/2000	Grand National Choral Festival	4500
07-14/07/2000	XIII International Aids Conference	10 000
19-21/07/2000	Annual Labour Law Conference	1000
10/09/2000	A Night Of 100 Stars	1680
23/09/2000	Durban Metro Music Festival	1680
13/10/2000	Foundation Elan Vital Conference	1200
29/11/2000	Political Debate	1680
18/03/2001	International Speaker's Seminar	1680
05-08/04/2001	Hirsch's Kitchen, Bathroom & Décor Faire	EXHIB
09/04/2001	Mind Power Seminar	1200
21-24/04/2001	Indaba 2001	2000
29/04/01-02/05/2001	Grace Outreach Ministries Meetings	3000
13-18/05/2001	WONCA World Conference (World Org Of Family Practitioners)	2500

04-06/07/2001	Annual Labour Law Conference	1 000
04-06/08/2001	A Night Of 100 Stars	1 680
31/08/01-7/09/2001	World Conference Against Racism, Racial Discrimination, Xenophobia And Related Intolerances	13 000
21/09/2001	The International Hotel School Exhibition	EXHIB
11-14/10/2001	DECOREX KZN and KBE KZN	EXHIB
24-26/10/2001	2001 Soroptimist International Conference	1000
27/10/01-02/11/2001	35th International Apicultural Congress (Apimondi)	1500
10/02/2002	IMBUMBA 2002	1600
03/05/2002	Heavyweight Comedy Jam Concerts	1640
11-14/05/2002	INDABA 2002	2000
15/05/2002	Iyanla Van Zant Seminar	1680
02/06/2002	JCWP 2002	3000
09/06/2002	Deepak Chopra International Speaker Seminar	2000
11-14/06/2002	14th Conference Of The IUATLD African Region	2500
01-11/07/2002	AU Summit 2002	5000
18-22/08/2002	SA Dental Association International Congress 2002	1500
01-06/09/2002	2002 XV International Congress For Electron Microscopy	1500
08-11/09/2002	SADTU Conference	1300
17-20/09/2002	SA Planning Institute Conference (SAPI)	1000
13/10/2002	Night Of 100 Stars	1000
18-25/10/2002	International Bar Association	1800
31/10/2002-04/11/2002	Miss India Worldwide Dinner & Pageant	1800
11-14/04/2003	Hirsch's Kitchen, Bathroom & Decor Faire	EXHIB
28/04/2003-10/05/2003	INDABA 2003	2000
24-30/05/2003	International Society Of Chemotherapy	2500
24-30/05/2003	2003 International Association Of Ports And Harbors	1000
18-19/06/2003	Engen Conference And Exhibition	1000

30/06/2003-05/07/2003	2003 International Political Science Association Congress	2000
26/07/2003-01/08/2003	2003 International Rangelands Conference	1000
04-07/08/2003	Southern African Aids Conference	3000
11-16/08/2003	International Cartographic Association 2003 Congress	1000
17-23/08/2003	Agricultural Economists	1500
08/09/2003-17/09/2003	5th World Parks Congress 2003	2000
21-23/09/2003	SARCDA Trade Show 2003	EXHIB
24-28/09/2003	Shotokan Karate-Do International World Cup	2000
20-26/10/2003	2003 22nd PIARC World Roads Congress	3500
11/11/2003	W&R SETA Presentation	1050
15/11/2003	Metro FM Music Awards	1680

APPENDIX 2: List of activities, which may have substantial detrimental effects on the environment". (Regulation R1182, *Environment Conservation Act, Act No. 73 of 1989*). (DEAT, 1989)

"1. *The construction, erection or upgrading of -*

(a) facilities for commercial electricity generation with an output of at least 10 megawatts and infrastructure for bulk supply;

(b) nuclear reactors and facilities for the production, enrichment, processing, reprocessing, storage or disposal of nuclear fuels and wastes;

(c) with regard to any substance which is dangerous or hazardous and is controlled by national legislation:
  (i) infrastructure, excluding road and rail, for the transportation of any such substance; and
  (ii) manufacturing, storage, handling, treatment or processing facilities for any such substance;

(d) roads, railways, airfields and associated structures;

(e) marinas, harbours and all structures below the high-water mark of the sea and marinas, harbours and associated structures on inland waters;

(f) above ground cableways and associated structures;

(g) structures associated with communication networks, including masts, towers and reflector dishes, marine telecommunication lines and cables and access roads leading to those structures, but not including above ground and underground telecommunication lines and cables and those reflector dishes used exclusively for domestic purposes;

(h) racing tracks for motor-powered vehicles and horse racing, but not including indoor tracks;

(j) canals and channels, including structures causing disturbances to the flow of water in a river bed, and water transfer schemes between water catchments and impoundments;

(k) dams, levees and weirs affecting the flow of a river;

(l) reservoirs for public water supply;

(m) schemes for the abstraction or utilisation of ground or surface water for bulk supply purposes;

(n) public and private resorts and associated infrastructure;

(o) sewage treatment plants and associated infrastructure;

(p) buildings and structures for industrial, commercial and military manufacturing and storage of explosives or ammunition or for testing or disposal of such explosives or ammunition;

2. *Agricultural or zoned undetermined use or an equivalent zoning, to any other land use*;

3. *The concentration of livestock, aquatic organisms, poultry and game in confined structures for the purpose of commercial production, including aquaculture and mariculture*;

4. *The intensive husbandry of, or importation of, any plant or animal that has been declared a weed or an invasive alien species*;

5. *The release of any organism outside its natural area of distribution that is to be used for biological pest control*;

6. *The genetic modification of any organism with the purpose of fundamentally changing the inherent characteristics of that organism;*

7. *The reclamation of land, including wetlands, below the high-water mark of the sea, and in inland waters*."

8. *The disposal of waste as defined in section 20 of the Act, excluding domestic waste, but including the establishment, expansion, upgrading or closure of facilities for all waste, ashes and building rubble*."; and

9. *Scheduled processes listed in the Second Schedule to the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965).*

10. *The cultivation or any other use of virgin ground*.
"*virgin ground*" means land which has at no time during the preceding 10 years been cultivated."

APPENDIX 3: WSSD : Facts and Figures (*Bonjanala* – Special Edition, Post WSSD Review, Edition 5, November/December 2002.

1. Accreditation

UN accredited figures as at 04 September 2002 which does not include accreditation for advisors, special envoys, etc.

- 8 927 Government delegates accredited
- 8 157 Major Group delegates accredited
- 3 921 Media accredited
- 34 793 service providers accredited
- **Total accredited: 80 635**

2. Accommodation

- 227 000 room nights (exclusive of Heads of State and hotels)
- 422 Hotels used
- 400 Home stays used
- Average stay was 12 days per participant

3. Transportation

Transport hubs/venues with daily passengers were:

Total: 4 709 passengers per day to various transport hubs

- SCC - 6 295 passengers per day
- Ubuntu - 3 321 passengers per day
- Nasrec - 2 485 passengers per day

Total: 12 000 passengers per day moved between venues

This excludes the use of private vehicles, company cars and hired cars (which many UN agencies utilized for the two week period)

4. Media

- 4 012 international and national media representatives accredited

5. Ubuntu Village

- 3200 000 visitors through the gate by the end of operations on 07 September 2002
- Over 40 countries exhibiting with over 440 exhibits in place
- Between 4 000 to 5 000 individuals conferenced at Ubuntu between 24 August and 04 September 2002.
- Over 20 Heads of Delegation and government Ministers from around the world visited Ubuntu
- The First Lady, Mrs. Mbeki and at least 15 other First Ladies visited Ubuntu
- Approximately 20 000 students visited Ubuntu Village by means of organized schools trips.

6. Tours

(a) Day Tours (Pre and Post) – including greening day tours and media day tours

- 6 tours before summit from 22 to 23 August
- 250 tours throughout summit from 24 August to 04 September
- 31 tours after the summit from 05 September to 09 September
- 287 total number of tours pre, during and post summit

(b) Number of tours per province and externally

- Approximately 500 in Cape Province
- Approximately 30 in KwaZulu-Natal
- Approximately 110 in Mpumalanga
- Approximately 10 Free State
- Approximately 100 in Limpopo
- Approximately 120 in Northern Province (Pilanesburg)
- Approximately 30 in North West Province
- Approximately 750 in national resorts and game reserves
- Approximately 07 in Botswana

- Approximately 20 in Zimbabwe
- Approximately 40 in Zambia (Victoria Falls and Livingstone)
- Total provincial and other tours: 1 745