RECYCLED BUILDING MATERIALS: THE LIKELY IMPACT ON AFFORDABLE HOUSING IN THE WESTERN CAPE

BY

MICHELLE TRAUT (B.Tech)

A THESIS PREPARED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS IN TECHNOLOGY (2001)

PENINSULA TECHNIKON

ABSTRACT

The construction industry globally, contributes between 18% and 24% of the GDP, and because of its labour intensive characteristics, contributes handsomely to total employment, forming important backward and forward linkages with the rest of the economy. Nevertheless, the extent and sophistication of these linkages crucially depend on the relative development of the construction industry relative to the overall economy. In the developing countries, these linkages are not very strong because of the use of informal materials, which is not commercialised and whose opportunity costs are often zero, and the huge imports of construction materials used in the modern sector of the economy. However, whether in the developed or developing economies, the construction industry is a major contributor to economic growth and development by providing the necessary infrastructure that facilitates production, consumption and recreational activities.

In fulfilling these activities, the construction industry generates huge wastes of which only a tiny proportion are recycled and reused. However, in economies and countries where adequate and functional housing is a problem mainly due to lack of affordability, recycling and reuse of construction waste is a necessary prerequisite to enhancing housing affordability in these countries. This is the current situation that South Africa finds itself where because of its past history of 'apartheid', economic opportunities and amenities were denied to the blacks. There is nowhere that this deprivation is more pronounced than in the built environment sector where housing shortages and general

disamenities prevail. High levels of unemployment further exacerbate the situation, which is a consequence of low skills and high illiteracy rates. Thus, housing demand and supply by this group of the population are most likely, on the evidence available, to fall predominantly within the low-income housing category. Presently, all households falling into this category rely on financial assistance from the government to facilitate low-cost housing consumption because of pervasive poverty, which itself is due to the very high unemployment rate, illiteracy, lack of skills and general deprivation: a legacy of 'apartheid' policies enforced by previous government. The dilemma however is how to meet the huge housing demand within the limited resources available to the government on the one hand, and on the other, to satisfy such demand without compromising the environmental sustainability of the physical environment.

Thus, the thesis aims to determine ways in which the construction industry could contribute to the sustainability of the carrying capacity of the biophysical environment and enhance social sustainability by facilitating affordability through the possible reductions to construction costs through recycling and reuse. By means of questionnaires and detailed interviews, underscored by a qualitative research approach, the potential of construction recycling and the possible contributions to environmental sustainability and housing affordability are determined. At completion, it is expected that this work will not only contribute to existing knowledge but would be of significance in terms of policy formulation to construction industry practitioners, central and local government policy makers, and other governmental and non-governmental organisations operating in the area of housing.

TABLE OF CONTENTS

ABSTRACT	i
LIST OF TABLES	vii
LIST OF FIGURES	xi
ACKNOWLEDEGMENTS	xii
CHAPTER 1 (Research Proposal)	1
1.1 Awareness of the Problem	2
1.2 Problem Statement	8
1.3 Research Objectives	
1.4 Hypothesis	9
1.5 Limitations to Study	
1.6 Definition of Concepts	
1.7 Assumptions	10
1.8 Significance of Research	
1.9 Research Methodology	11
1.10 Structure of the Dissertation	
CHAPTER 2 (Literature Review)	13
2.1 Introduction	14
2.2 Housing Needs, Housing Affordability and Environmental Sustainability	
2.3 Recycling Definition	17
2.4. Critical Assessment of Recycling	

2.5 International Recycling Trends 18

2.6 Recycling Process 20

2.7 Recycling Successes 21

2.8 Recycling Hindrances

2.9 Interface Between Housing, Affordability, and Recycling 24

2.10 Conclusion 25

CHAPTER 3 (South Africa's Housing Situation in a Global Context) 26

3.1 Introduction 27

3.2 Housing problem in the Global Context

3.3 South Africa's Housing Situation 34

3.4 South African Housing Policy 42

3.5 Conclusion 47

CHAPTER 4 (South Africa's Biophysical Environmentand Housing Provisions) 49

4.1 Introduction 50

4.2 South Africa's Biophysical Environment

4.3 South Africa's Climatic and Atmospheric Environment 58

4.4 Sensitivity of South Africa's Biophysical Environment to Housing Construction 59

4.5 Environmental and Physical characteristics of low-cost housing in SA 60

4.6 Conclusion 66

CHAPTER 5 (Research Design) 68

5.1 Introduction 69

5.2 Experimental Research

5.3 Case Study 70

5.4 The survey method 72

5.5 Interviews and Questionnaires 73

5.5.1 Advantages of open-ended questions 75

5.5.2 Disadvantages of open-ended questions 76

5.5.3 Advantages of structured questions

5.5.4 Disadvantages of structured questions

5.6 Quantitative Research Approaches 77

5.7 Qualitative Research Approaches

5.8 Triangulation Method

5.9 Descriptive Research 78

5.10 Reliability of Research

5.11 Research Methodology Chosen, Justification, and Problems Encountered 79

5.12 Rational for the Questions Asked 80

5.12.1 Homeowners Identity Details

5.12.2 Property Type 81

5.12.3 Housing Affordability

5.12.4 Environmental Issues 82

5.12.5 Professional Stakeholder Identity Details

5.13 Conclusion

CHAPTER 6 (Empirical Analysis of Primary Data) 84

6.1 Introduction 85

6.2 Key to the Analysis

6.3 Survey Results: Homeowner

6.4 Survey Results: Professional Stakeholder 110

6.5 Conclusion 131

CHAPTER 7 (Policy Prescription And Conclusion To This Study) 132

7.1 Introduction 133

7.2 Policy: Focus and Response 134

7.3.1 Policy to Render Recycled Materials Available 135

7.3.2 Design Formulation 136

7.3.3 Waste management

7.4 Strategic Implementation 137

7.5 Conclusion

REFERENCES 139

APPENDIX 1 (Questionnaire) 153

APPENDIX 2 (Cross Tabulation) 158

LIST OF TABLES

Table 1. Quantities of Construction and Demolition Waste Generated in Some Selected Countries 4

Table 2. Analysis of Embodied Energy Content and Gas Emission for Three Construction Material 6

Table 3.1 Average Number of People Per Room in Occupied Dwellings in Urban Areas in Developing Countries (1960-1980) 28

Table 3.2 Extent of Slums in African Cities (1995) 29

Table 3.3 Demographic Indicators: Estimates and Projections for SSA by Subregion and Country, 1990 31

Table 3.4 Demographic Indicators: Estimates and Projections for SSA by Subregion and Country, 1990 (Under 15\ Over 65, Percentage Urban Population) 32

Table 3.5 Percentage of Population that is Urban in Africa, Latin- America and Asia (1920 – 2000) 33

Table 3.6 Backlog in Housing (1990) 36

Table 3.7 Unemployment by Population Group (Ages 15 – 65) 37

Table 3.8 Population Forecast for 2000 38

Table 3.9 Provincial Development Indicators 39

Table 3.10 Subsidy Requirements by Households October 1995 41

Table 3.11 Subsidy Categories per Monthly Income 45

Table 4.1 Present and Projected Water Demand 57

Table 6.1 Area of Residents 86

Table 6.2 Sex 87

Table 6.3 Number of Residents

Table 6.4 Number of Adults 88

Table 6.5 Number of Children

Table 6.6 Number Employed 89

Table 6.7 Type of Employment

Table 6.8 Housing Material Used 90

Table 6.9 Number of Rooms 91

Table 6.10 Number of Doors 92

Table 6.11 Number of Windows 93

Table 6.12 Electricity Connection

Table 6.13 Running Water Connection

Table 6.14 House Sizes 95

Table 6.15 Do You Own Your House?

Table 6.16 Type of Housing Finance 96

Table 6.17 Additional Rooms Required

Table 6.18 Satisfied with Housing Materials Used 97

Table 6.19 Satisfied with Residential Area 98

Table 6.20 Areas Suitably Developed 99

Table 6.21 State of Infrastructure 100

Table 6.22 Importance of Surrounding Area to Quality of Your Life 101

Table 6.23 Rate Importance of Environmental Issues

Table 6.24 Environment Being Part of All Your Activities At Home

Table 6.25 Shortage of the Following Materials 102

Table 6.26 Can the Rate of Production Of Building Materials Be Sustained 103

Table 6.27 Production of Building Materials Harmful to the Environment

Table 6.28 Different Methods of House Building 104

Table 6.29 Alternative Materials in House Building

Table 6.30 Use of Second-hand Building Materials 105

Table 6.31 Experience with the Use of Recycled and/or Used Building Materials

Table 6.32 Material/Components Used in Housing Construction 106

Table 6.33 Recycled and/or Used Construction Material Depot 107

Table 6.34 Availability of Recycled Materials 109

Table 6.35 Recycled Material Reasonably Cheaper than New Material

Table 6.36 The Process of Recycling Will Help in Saving the Natural Resources

Table 6.37 Recycling Will Contribute Towards Reducing the Cost of Construction

Table 6.38 Category of Employment 111

Table 6.39 Under Which Municipal Area Do You Fall?

Table 6.40 What Position Do You Hold in Your Organisation? 112

Table 6.41 Does Your Organisation Have an Environmental Policy? 113

Table 6.42 Is Your Policy Attached to Agenda 21 and/or LA21?

Table 6.43 Consultation with Stakeholders During Policy Formulation

Table 6.44 Was the Information Incorporated into Your Policy? 114

Table 6.45 Strategies for Sustainable Development is Considered at Planning Stage

Table 6.46 Impact of Availability of Material on the Design Process 116

Table 6.47 Impact of Local Availability of Material on the Design Process

Table 6.48 Is Material Supply Availability Unlimited?

Table 6.49 Perception of Low-cost housing Design 117

Table 6.50 Important Factors In Not Providing Adequate Housing

Table 6.51 Requirements in Order to Change Low-cost Housing to Adequate Housing 119

Table 6.52 Alternative Housing Methods & Innovative Material Usage Can Result In Developing Adequate Housing 121

Table 6.53 Consider Recycled Material as an Alternative Method of Housing 122

Table 6.54 Consider Recycling in Planning Stage of Contract

Table 6.55 Consider Recycling in Plan Stage of Contract

Table 6.56 Consider Carrying Recycled/Used Material as Stock Item 124

Table 6.57 Material/Components Included In Stock

Table 6.58 Recycled Material as Economically Viable (Generate Income) 125

Table 6.59 A Substantial Potential Market for Recycled Material

Table 6.60 If You Said Maybe/No, Motivate 126

Table 6.61 Recycled Material Form Part of Specification for Future Housing Provision 127

Table 6.62 Future Policy Include for Salvage of Reuse/ Recyclable Material

Table 6.63 Indicate the Best Location for Recycled Material Depot 128

Table 6.64 Use of Recycled Material Contribute to Sustainable Construction 129

Table 6.65 Use of Recycled/Reusable Material for Housing Construction Would Be Acceptable to Potential Housing Consumers

LIST OF FIGURES

Figure 3.1 Projects Approved 36

Figure 3.2 Subsidies Approved 40

Figure 4.1 Biomes of South Africa 51

Figure 4.2 Distribution of Wetlands in South Africa 52

Figure 4.3 Natural Vegetation Converted into Agriculture 53

Figure 4.3.1 Reduction in the Natural Extent of Wetlands

Figure 4.4 Population Growth in South Africa 54

Figure 4.5 Effluent Pipelines in South Africa 55

Figure 4.6 Trends in Atmospheric Concentration CO_2 58

Figure 4.7 A Typical Site Plan for Low-cost Housing in South Africa 61

Figure 4.8 – 4.10 A Typical Low-cost Housing Development

Figure 6.1 Area of Residence 86

Figure 6.2 Housing Material Used 90

Figure 6.3 Number of Doors 92

Figure 6.4 Areas Suitably Developed 100

Figure 6.5 Shortage of the Following Materials 103

Figure 6.6 Material/Components Used in Housing Construction 107

Figure 6.7 Important Factors In Not Providing Adequate Housing 118

Figure 6.8 Requirements in Order to Change Low-cost Housing to Adequate Housing 120

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the many individuals and corporate bodies for their valued contributions to this dissertation. Iam indebted to the National Research Foundation (NRF) of South Africa for providing the grant that facilitated this study. I thank Mr A.J. Rodriques, for supervising me and for contributing his time and resources to the study. I am also very grateful to all the respondents for their time to complete the questionnaires. To all my friends, I would like to let you know that your support was a source of strength to me throughout the period of this research. I would like to express my sincere gratitude to Dr Ebohon for his time, wisdom, guidance and support without which I would not have completed this report. I would also like to thank Peninsula Technikon for offering me teaching opportunities and all the staff of the Department of the Built Environment for their friendship and support.

Lastly but not least, I would like to dedicate this work to my parents Mr and Mrs Traut and my beloved family. To say that this work was completed with their selfless and immense contributions is an understatement.

Michelle Traut

CHAPTER 1:

GENERAL INTRODUCTION

1.1 Awareness Of The Problem

The threat of housing to the biophysical environment is perhaps the single most important issue commanding global concern at present because of the direct manifestations of environmental degradation and pollution (World Council For Economic Development, 1987). Globally, incidents of flooding, mudslides, high variability in global weather pattern, and the disappearance of biological species, including flora and fauna have become incessant and more frequent than say 50 years ago. However, such environmental destruction occurs against the background of the insatiable demand made upon the environment by mankind in meeting their daily basic needs. The reality however, is that most of these resources are depletable and non-renewable, calling for managed approach to global natural resource consumption, which has become the ethos of environmental sustainability.

Nowhere has the demands on the physical and biotic environment manifested so much than within the built environment, especially housing. Globally, there is huge demand on the biophysical environment for housing provision together with other built environment infrastructure. The scale of such demand is measured by the fact that the built environment accounts for one-sixth of total global freshwater consumption. In a similar vein, the built enviroment accounts for between 30-40% of total global energy consumption. Apart from raw material consumption, the built environment also generates huge waste, and this represents between 20 and 30% of total global waste. Clearly, the built environment exerts formidable pressures on the biophysical environment and for

this reason that initiatives such as recycling and reuse of construction waste are being strongly advocated.

The issue of housing is of particular concern given the global population, which is estimated over a billion people that are without adequate or decent housing and housing services (World Bank, 1993). Given such levels of housing deprivation, it is hardly surprising that in the mid-1980s housing became a focal concern for United Nations, which resulted in the global shelter strategy initiative and a target date of 2000 was established (UN, 1988). In this document, housing was shown to transcend its physical presence and was defined to include additional attributes, including its capacity to empower households towards effective and sustainable social development (UN, 1988). These key additional attributes include the wealth generating capabilities of housing, particularly employment. It is in this sense that the strategy for shelter encourages all stakeholders right from the government through to entrepreneurs, artisans, process workers and the community itself to play an enabling role in the process of shelter provision for the unsheltered. Thus the government should enable the process through targeted policy formulation while contractors and the community should be empowered through strategic training to ensure that the target of providing housing units for the estimated 1 billion homeless could be met. From a priori observation, this strategy has proved rather ambitious as the target was hardly achieved.

One of the main obstacles has been the lack of economic growth from which more employment and income could be generated for the individual and government, which

could be devoted to housing provision. Escalating housing costs has added further complication whereby the demand and consumption of housing has been suppressed.

Thus, it is imperative that housing costs are reduced in order to enhance housing affordability. One area concentrating attention at the moment is recycling and reuse of construction wastes. As indicated in Table 1, huge wastes are generated annually by the construction industry, which could be recycled and reused but end up as landfills.

Table 1

Quantities of Construction and Demolition Waste Generated in Some Selected Countries

Country	Quantity (Mtpa)*	Generation Rates (t/cap/a)	% of Total Waste**
UK	70	1.25	20
USA	100	0.5	20
Germany	23	0.3	-
Netherlands	15	1.0	-
Australia	2.1	-	15
Canada	9	-	30
France	25	-	-
Japan	25.4	-	-
Europe (Total)	175-370	0.5-1	25-50

Source: Macozoma, and Benting, (1999).

* Million tons per annum
** Percentage of total solid waste produced

As Table 1 shows, construction wastes account for a significant proportion of total wastes, which if recycled and reused could have significant impact on the biophysical environment by virtue of the attendant reductions to new materials and products. Globally construction and demolition waste production is roughly estimated to stand at a staggering 2 to 3 billion tons per year (Torring, 1998). For developing countries it is estimated that between 0.2 to 0.5 kg per capita per day is generated, and in terms of density between 400 and 700 kg per m^2 (Benting, 1999).

The likely environmental benefits from recycling can be seen in Table 2, where the energy embodied in the production of selected building materials and the amount of pollution generated, as a result is presented.

Table 2: Analysis of Embodied Energy Content and Gas Emission for Three Construction Materials

	Emission per Kg product (dry material		
Gas types	**Structural timber**	**Roof truss**	**Cladding boards**
CO_2	95.7g	98.4g	94.1g
CO	5.91g	8.33g	5.83g
NO3	3.39g	4.02g	3.34g
SO2	0.112g	0.121g	0.110g
	Some selected raw materials consumed per product (dry material)		
Wooden raw material **(wet/dry)**	4900/2660g	5400/2940g	4830/2750g
Phosphate fertilisers	0.300g	0.331g	0.295g
Nitrogen fertilisers	1.71g	1.88g	1.61g
Potassium fertilisers	0.300g	0.331g	0.295g
Pesticides	0.0173g	0.0191g	0.0170g
Fossil fuels	1.40MJ	1.38MJ	1.38MJ
	Renewable energy (Higher heating value of logs)		
Renewable energy **(Higher heating value of logs)**	54.6MJ	60.2MJ	56.5MJ
Fossil fuels	1.40MJ	1.38MJ	1.38MJ
Electricity	0.0140MJ	0.0100MJ	0.00695MJ

Source: Hakkinen (1994).

Evidently, apart from the possibility of achieving housing affordability through recycling and reuse of construction wastes, the benefits to global biophysical environment is also huge (Hakkinen, 1994, John and Tinker, 1998). A glimpse at Table 1 indicates the material inputs to the manufacture of construction materials. Three building materials commonly employed in construction activities have been considered for this analysis. The first noticeable implications are the presence of 'green-house' gases and embodied energy during the manufacturing process of these materials. These materials include; structural timber, roof trusses, and cladding boards. Table 1 shows the amount of CO_2, CO, N O_x, and SO_2, released during building material processing. Thus, recycling and reuse of construction material, while contributing to housing affordability can also have a major impact on environmental sustainability.

Apart from the energy embodied in manufactured construction materials and the attendant pollution, there are other resources inputs that have equal consequences for the biophysical environment. In the construction of housing, land availability is a crucial factor. The intensity of housing construction activities worldwide results in the loss of as much as 25 000 hectares of vegetation annually (Quarrie, 1992). Similarly, the serious situation which exists regarding land usage was highlighted at the Rio Summit, resulting in a call for a new approach to urban development (CSIR, 1999). In South Africa, great concern over land use has resulted in the use of underdeveloped land and the conversion of unused buildings as well as the densification of settlements of urban land (CSIR, 1999).

Arguably, it is possible to ameliorate the huge housing backlog in countries such as South Africa through concerted recycling and reuse efforts, and through sustainable and imaginable building designs, while equally benefiting the biophysical environment immensely.

1.2 Problem Statement

The problem considered in this thesis relates to a priori observation that high low cost house prices in South African impinges on housing affordability: a situation that can be ameliorated by recycling and reusing of construction wastes. The biophysical environment, resulting from the savings on natural resource consumption feels the wider benefits.

1.3 Research Objectives

The main objective is to provide a coherent analysis of how housing costs can be reduced by encouraging and widening the practice of recycling and reusing of construction materials in low-cost housing production and delivery. To this effect, and by focusing mainly on the low-cost housing sector, the following additional aims have also been pursued:

- to establish the extent to which building materials are recycled in South Africa's construction industry
- to establish the problems associated with building material recycling
- to determine the construction industry's current recycling policies and practices

- to identify the necessary policies to encourage the recycling of building materials in South Africa's construction industry
- to contribute to current debates on environment and development

1.4 Hypothesis

The recycling of building materials will enhance low cost housing affordability and contribute to environmental sustainability through the massive savings on natural resource consumption, and hence a significant reduction in the rate of natural resource depletion.

1.5 Limitation of the Study

This study is limited in geographical coverage to the region of the Western Cape and in particular, Western Cape. The project looks closely at the status of recycling and reuse of building materials by various stakeholders, including construction firms, local authorities, private individuals and other related construction professionals.

1.6 Definition Of The Concepts Used In The Thesis

The following definitions need to be specifically explained in the context in which they are used within the study:

- Recycling - the process of converting construction waste (already used) materials into reusable materials within the construction industry.
- Building materials - materials used in the construction of all buildings especially those employed in the production of low cost housing.

- Affordability - implies the ability of the attainment of housing and is commercially driven in that it affects supply and demand.
- Low-cost housing - all housing which in their construction is geared to minimise costs of labour, plant and materials.
- Sustainability - the degree to which any process lends itself to supporting the natural environment and ensures its posterity.

1.7 Assumptions

It is assumed that within the South African construction and housing industry, recycling and reuse are uncommonly practised and that there might be problems with data. Nevertheless, it is assumed that sufficient primary and secondary data and information would be available to be able to accept or reject the null-hypothesis in favour or otherwise of the alternative hypothesis.

1.8 Significance of the Research

This study is significant in that it focuses on one of the main challenges facing South Africa, which is how to ameliorate the impinging impact of high house prices on housing affordability, especially low-cost housing relative to high unemployment rate and low income levels. As indicated above, the building industry consumes a great amount of natural resources. Apart from the direct resource consumption, the manufacturing of the materials used in construction involves huge energy consumption and the emission of 'green house' gases.

It is the aim of this work to show that through recycling and reuse of building materials, housing affordability can be significantly enhanced, and that natural resource depletion, including the attendant impact on the environment can be minimised as already indicated above. Therefore recycling could contribute a great deal to environmental sustainability and development while at the same time contributing to housing affordability (John and Tinker, 1998).

1.9 Research Methodology

The methodology employed in this research includes qualitative and quantitative techniques, which include a literature review that sets out the theoretical framework to the thesis that is validated empirically. Literature on environmental sustainability, recycling and reuse of construction materials, and housing affordability are critically analysed while at the same time, the interconnecting interface between these issues has also been critically analysed. Primary data was obtained by questionnaire on the state and practice of recycling and reuse of construction materials in low-cost housing construction and delivery. The data gathered has been analysed and conclusions drawn with some recommendations regarding meeting the enormous housing needs of South Africans without compromising the biophysical environment.

1.10 Structure of the Dissertation

Chapter one presents the introduction to the dissertation. Chapter two is the literature review on environmental sustainability and low-cost housing and the problems of affordability. Chapter three looks at sub-Saharan Africa's situation, the extent of poverty throughout the region, the way in which culture and politics and the economy influence

shelter provision and how government's strategy is shaped as a result. Chapter four focuses on environmental sustainability, especially its interface with the housing sector regarding the huge demands on the physical environment and natural resources. However, the analysis has a global flavour, which is necessary in order to show sub-Saharan Africa's performance in the global economy and in particular, South Africa. Thus, the extent to which building materials are recycled and reused within South Africa's construction industry remains the focus of this chapter.

Chapter five documents the research methodology and the choice of research technique employed for data analysis. It also discusses the process of data gathering and the problems encountered during fieldwork. In chapter six, the data is critically analysed and chapter seven heralds the conclusion to the study.

CHAPTER 2:

LITERATURE REVIEW

2.1 Introduction

This chapter provides the theoretical framework to the thesis by reviewing previous literature and evidencing the justification for this research. This is particularly the case with regards to South Africa where concerted efforts have been made to deliver housing to meet the enormous demands by the population. The nature of this demand has strong political undertones given the fact that Blacks are hardest hit when it comes to housing shortages and housing backlogs (South Africa Housing Advisory Council, 1992). Such disproportionate share of housing deprivation is also reflected in employment and income, rendering housing affordability a very complex socio-political and economic issue.

However, such complexity is further complicated by the huge number of houses required to satisfy housing needs, and given the natural resource intensity of housing construction, the environmental implications of satisfying housing needs could be enormous unless controlled (South Africa Housing Advisory Council, 1992).

2.2 Housing Needs, Housing Affordability and Environmental Sustainability

Globally, housing shortages and hence housing needs represent one of the most visible signs of human deprivation. This is particularly the case because of the vital role played by housing in socio-economic development (UN, 1976). Apart from offering the physical environment from which families and society are sustained, it affords the opportunity by which the individual and the family as a unit, bind with society.

This renders housing as an important instrument for socio-economic development (UNCHS/ILO, 1995). Indeed, all the possible areas of socio-economic intervention to improve human lives, including health and education starts with the household, which is why housing is, a basic human right (S.A. Housing Act, 1995).

Nevertheless, the proportion of global population without shelter stands at more than 1 billion people as well as more than 1.1 billion people lack access to clean water and sanitation while another billion people suffer from indoor pollution (World Bank, 1992). Despite the universality of these problems, they are nevertheless more pronounced in the developing countries, especially the least developed that are less likely able to deal with the adverse consequences of inadequate housing. The inability to respond to housing demand or deal with the consequences of poor housing derives from the economic characteristics of these economies, which is exemplified by mono-culture where one or two commodities account for more than 90 percent of the foreign exchange requirements to facilitate global trade. This apparent lack of economic diversification increases the vulnerability of these countries to global economic fluctuation, exacerbating their economic problems, especially with regards to housing and infrastructure provisions.

In the developing countries, inadequate housing is far more pronounced and mirrored by high rates of overcrowding and the huge proportion of the population without shelter (UN, 1994). The task of providing adequate shelter for the population is proving an onerous task, principally owing to pervasive poverty, which is exacerbated by inadequate skills and widespread unemployment in the developing countries. Thus, housing delivery

has to be affordable to the poor, which can only be realised through innovative housing construction and delivery. This requires a detailed and critical appraisal of material inputs to construction in view of identifying possible areas where most savings could be made to enhance the fundamental objective of affordable housing.

In focussing on material input for housing, reuse of recycled building materials is considered as a possible candidate through which housing costs can be significantly reduced, especially given that these materials are presently discarded. Similarly, the procurement of these buildings can be another source of dramatic cost reductions by involving all the stakeholders, especially those expected to take ownership of these houses. By emphasising the use of recycled materials and involving low-cost housing consumers in the construction process, the two most important pillars of environmental sustainability as detailed in UN Agenda 21 is achieved. Thus, the quest for innovative solutions to housing problems for the developing countries by seeking new ways to enhance affordability through the use of recycled materials, remains the focal point of this investigation.

2.3 Recycling Definition

Recycling is a process, which uses recovered materials to make new products and the value of recycling lies primarily in the fact that all products derived stem from used materials (International Waste Management Board, 1995). There is a fine line between the reuse of materials and the recycling of materials. In most cases recycling can involve the expense of more environmental assets or capital but there are instances where recycling simply means the rescue of products from waste dumps which can be reused in their current forms without additional processing. This is why it was asserted in the beginning that the dividing line between recycling and re-use of building materials is vague, but a distinction needs to be drawn as the concepts are often confused by many experts on recycling (Thorne, 2000).

2.4 Critical Assessment of Recycling

Recycling of waste products has several advantages and confers numerous benefits on the biophysical environment. Waste poses one of the most formidable threats to the global environment and imposes huge costs on infrastructure maintenance, especially urban drainage owing to poor waste management. In this regard recycling is of immense benefit to the global environment, as it is now acknowledged that over 50 percent of discarded materials can be recycled and be reused or transformed into new products (Integrated Waste Management Board, [IWMB] 1999). Other benefits of reuse and recycling of materials include huge savings on global environmental assets and a whole new set of industries associated with recycling, which has huge job potentials, emphasizing new skills.

The use of recycled- content building products provides a proactive rather than a reactive approach to waste management problems, it also provides benefits to society such as the conservation of resources and energy and it creates new markets for recovered materials. (IWMB, 1999) Potential cost savings can only be fully realized when building with environmental considerations in mind, which include the designing of buildings, construction of buildings, renovation of building, and the operation of buildings with regards to global environmental sustainability (IWMB, 1999). Indeed, IWMB (1999) asserts that a reduction of 20 to 75 percent of running cost is possible with ecologically designed buildings compared to buildings constructed and operated with no environmental sustainability in mind.

However, there is a view that recycling is not the answer to all environmental and economic problems, and that its strength lies in the fact that it is part of a process, which is waste management. Similarly, it has also been asserted that recycling activities could be as resource intensive as new products, and nowhere is this more pronounced than in the area of energy consumption. From the environmental point of view, it would have been more preferred if all materials are reused without further processing but the nature of certain materials demand reprocessing (Thorne, 2000; IWMB, 1995).

building regulations

2.5 International Recycling Trends

In the developed or Organisation for Economic Cooperation and Development (OECD) countries, especially the European Union a well-developed culture of recycling exist.

This has been the result of concerted efforts by OECD governments in appreciation of the enormous strain currently endured by the global biophysical environment from human activities. For example, Denmark recycles approximately 80% of its infrastructure material wastes, while Holland manages the recycling of about 60% of its infrastructure material wastes. Similarly, Australia and the United States also use recycled construction materials extensively, especially crushed demolition aggregates. Other OECD countries such as Italy have embarked upon extensive research on concrete made from recycled material and the results confirm adequate compressive strength values that exceeds minimum legal requirements (Dessy, *et al.*, 1998).

However, differences can be gleaned from the commitments by countries to recycling. For example, while Italy has researched and found recycled concrete of adequate strength, the wider application of the product has been restricted (Dessy, *et. al.*, 1998). The differences in the commitments to recycling can be explained by the economic viability of recycling technology and the degree of the environmental impact of recycling environmental impact of recycling (John, Tinker, 1998). In the Unites States, the recycling trend closely follows an integrated waste management path. In several cities of the United States such as California the amount of waste generated is earmarked for 50 percent reduction. An overall package which, whilst not discarding recycling, concentrates on reducing waste by seeking to influence community attitudes towards waste generation is considered more effective.

Const. process

2.6 Recycling Process

The recycling process is still in its infancy even though the European Union and many American States such as California have high expectations for greater percentages of recycled material content in new products (IWMB, 1995). This is reflected by the fact that until 1996, ISO 9000 and 14000, that are standards for recycled products and environmental management were not available. Before products can be popularly used product specifications need to be determined. This is a complicated process, which involves various stages (IWMB, 1999).

As the recycling process generates new products, which would be of economic value to construction, these products would of necessity have to follow the construction product approval process. This requires the specification of the product, which should normally include such characteristics as colour, size, performance and material content. Furthermore, factors such as dimension, strength and texture would also require specification. In the absence of such specifications, architects and construction practitioners may not be able to innovate these new products in construction (IWMB, 1999).

Thus, the success of any recycling efforts is predicated upon the acceptance of recycled materials by constructional practitioners and clients as an integral part of the construction process.

2.7 Recycling Successes

The success of recycling can best be gauged by the amount of waste material, which is recycled. As already indicated above, Denmark and Holland achieve 80 percent and 60 percent recycled construction products respectively. In Sweden, 2.5 billion tons of materials is incorporated in buildings. This success is mostly felt in metallic waste with a recycle rate of 70% and glass, which has a recycling rate of 35%. Although this may sound impressive, other materials such as plastic, plaster boards, mineral wood, ceramics, and concrete are dumped or used as land infill (Tolstoy, Bjőrklund and Carlson, 1998). Thus, the potential for recycling, leading to reuse and reductions in global natural resource consumption is huge.

However, despite the huge potential discussed above, insufficient work has been done on the benefits of recycling, especially outside the immediate confines of environmental consideration such as housing affordability and the attendant employment and income benefits. These environmental benefits and the additional social benefits associated with recycling remain the focus of this work.

2.8 Obstacles To Recycling

While it is generally acknowledged that recycling has tremendous environmental and non-environmental benefits, the innovation of the concept has been very slow due to several identifiable obstacles. The first obstacle is one of lack of awareness by key players such as the authorities, developers, contractors, and the wider communities of the benefits of recycled materials. Secondly, the attendant costs of recycling is a major

problem owing to the need to demolish with a view to recycling and to create the opportunity for reuse of recycled materials (IWMB, 1999, Torring, 1998). In order to achieve recycled construction materials of high quality and suitablity for reuse, there is the need to demolish manually (Construction Industry Environmental Forum [CIEF], 1994). However, such a process is labour intensive and very expensive. Aside, and from a health and safety point of view, the labour intensive method involves a higher degree of risks and as a result, more supervision and additional staff training is necessary. Furthermore, the fact that recycling practices remain unstandardised also has serious financial implications.

Time is another obstacle to recycling, as the demand to keep within construction schedules restrict the time available for reuse, sensitive demolition procedure and require a speedier demolition method. One of the quickest methods of demolition includes the use of explosives, which often reduces materials to very limited use, as they are frequently reduced to rubble by this method of demolition. Similarly, the time frame also limits the opportunity contractors have to search for suitable materials for recycling and reuse (CIEF, 1994). It is evident from the ongoing discussion that the demolition methods employed as well as time constraints can affect the quality of recycled materials.

Other constraints include building standards and specifications, which must be revised from their present conventional standards and specifications to take account of the huge potential offered by recycled materials. Building designers and engineers currently reject the use of recyclced materials due to it falling outside conventional specifications.

Similarly, financial and economic constraints are other forms of obstacles facing recycling and reuse of construction wastes. This results from the fact that recycling is capital intensive financially and technologically. While this constraint prevails in all countries, it is more pronounced in the developing countries where there are fierce competing demands for the limited funds available.

Additionally, the market for recycled products is undeveloped and has formidable obstacles to overcome. Prominent among these sets of obstacles is the perception of recycled materials as inferior products by the public and built environment professionals, which forestalls the development of a market for recycled materials. Similarly, the lack of an effective supply chain for recycled materials is also a major obstacle as this raises the issue of uncertainty with regards to supply, which is discouraging to potential users of recycled construction products.

These problems are a direct result of ineffective recycling policies on the part of many governments around the world. The nature of recycling activities requires the support of the government, given the associated huge external benefits in terms of its impact on global environmental sustainability. Such policies must be underpinned by a combination of subsidies and grants to encourage recycling and the use of recycled materials. It would also require the augmentation of existing building regulations to facilitate the use of recycled building materials. However, these efforts must be complimented by proper and accurate information about the benefits of recycling to all stakeholders (Sparnicht and Sheehan, 1999).

2.9 Interface Between Housing, Affordability, and Recycling

The main aim of considering the interface between recycling and housing affordability is to evaluate the possibility of drastically reducing housing costs for those on lower income scales through the use of recycled construction materials. The fundamental problem of shelter provision for the poor is the presence of a large group of people who cannot afford to provide themselves with decent accommodation. It is hardly surprising that the World Bank has estimated that more than a billion of the global population have no shelter as a result of poverty.

As a result, vast and giant slums have become permanent features of most urban cities of the developing world. This scenario is further complicated by the high growth in population and rapid rural to urban migration. According the World Bank, by the end of the last century, 90 percent of the poor in Latin America, 45 percent of the poor in Africa, and 40 percent of the poor in Asia would be living in urban cities (World Bank, 1993a). Meeting the housing needs of such rapidly increasing global population has obvious implication for the biophysical environment as shown in Table 2. As already argued above, the need to revisit materials input into housing construction is overwhelming, leading to calls to recycle construction wastes into new buildings. Given the huge amounts of construction wastes presently generated annually as shown in Table 1, recycling these wastes into new buildings would definitely have significant impacts on the environment.

Assuming minimal recycling costs, the benefits of recycling and reuse of construction wastes in new housing construction could have significant downward pressure on housing costs and hence on affordability. Thus, there is clear interface between the recycling of construction wastes, environmental sustainability, and affordability, presenting a classic win-win situation.

2.9 Conclusion

Recycling is a complex activity that needs to be actively supported by governments because of the overriding environmental benefits. Above the immediate environmental benefits, recycling and reuse of construction wastes has the potential to drastically reduce housing costs and render housing affordable to the global population that currently have no access to decent housing. However, recycling is confronted by numerous obstacles, which would have to be addressed for the concept to become widely practiced and for recycled construction wastes to become acceptable to construction practitioners as quality building materials. This is unlikely to happen if current building regulations and codes are retained.

In the next chapter the housing situation in South Africa and the demand for low-cost housing is considered, particularly from the stand point of the implications for building and the likely impact on the environment, thereby seeking to validate the need for recycling.

CHAPTER 3:

SOUTH AFRICA'S HOUSING SITUATION IN A GLOBAL CONTEXT

3.1 Introduction

This chapter considers the housing situation in South Africa where particular attention is focussed on housing needs and housing provision. Further attention is paid to the impact of population growth and the attendant need for more housing. However, in order to put South Africa's housing situation within perspective, the global housing situation has been briefly considered where sub-Saharan Africa remains the main focus.

3.2 Housing Problems in the Global Context

The general deterioration of global housing and the attendant effects on the global biophysical environment is reflected by the fact that well over a billion global citizens have no adequate shelter (World Bank, 1992). As an indication of the inadequacy of such shelters, it is estimated by the World Bank that there are over a billion people throughout the world that suffer from indoor pollution of various kinds (World Bank, 1992). Various other manifestations have occurred in overcrowding, giant slums, and deteriorated urban environment as a result of inadequate housing. While the problem is universal, it is most pronounced in the developing countries.

Table 3.1

Average Number of People Per Room in Occupied Dwellings in Urban Areas in Developing Countries (1960-1980)

Country	1960		1970		1980	
	Year	Average	Year	Average	Year	Average
Afghanistan	-	-	-	-	1979	1.9
Argentina	1960	1.3	1970	1.4	1980	1.2
Bangladesh	-	-	1973	3.1	-	-
Brazil	-	-	1970	1.0	1980	1.0
Cameroon	-	-	1976	1.2	-	-
Chile	1960	1.6	1970	1.3	1980	1.0
Colombia	-	-	1973	1.6	1983	1.4
Costa Rica	1963	1.3	1973	1.4	1984	1.2
Cuba	-	-	1970	1.1	1980	1.0
Ecuador	1962	2.1	1974	1.9	1982	1.3
Guatemala	1964	1.9	1973	1.6	1986	2.0
India	1960	2.6	1971	2.8	-	-
Iran	1966	2.2	1976	1.8	-	-
Libya	-	-	1973	1.8	-	-
Mexico	1960	2.6	1970	2.2	1980	2.3
Pakistan	1960	3.1	1973	2.7	1980	3.2
Panama	1960	2.1	1970	1.8	1980	1.6
Paraguay	1962	2.6	1972	1.7	1982	1.6
Peru	1961	2.0	1972	1.8	1981	1.8
Philippines	-	-	1970	2.1	-	-
Korea	1960	2.8	1970	2.7	-	-
Sri Lanka	1963	2.1	1971	2.7	1981	2.3
Tunisia	1966	2.7	1975	2.6	-	-
Uruguay	1963	1.5	1975	2.1	1985	1.7
Venezuela	1961	1.6	1971	1.5	1981	1.4

Source: United Nations (1994).

As evident in Table 3.1, most developing countries have either marginally improved or have not improved at all on housing indicators measuring overcrowding. If the case of some countries like Pakistan is revisited, its overcrowding rate which improved in the 1970s began rising again in the 1980s. This is explained by a common phenomenon

experienced by most developing countries, which accentuated in the 1980s, that being, rural urban migration and the phenomenal growth rate in population, especially urban population. As a result, existing housing infrastructure was overwhelmed by the attendant phenomenal demand. This apparent inability to increase housing supply to meet increasing housing demand has become the defining characteristics of the developing countries' housing sector (World Health Organisation [WHO], 1992).

This is particularly so in the urban areas where, as a result of increasing urbanisation, housing demand outstrips housing supply. As shown in Table 3, increasing proportion of sub-Saharan Africa's urban population resides in the cities.

Table 3.2

Extent of Slums In African Cities (1995)

COUNTRY	CITY	YEAR	POPULATION (000)	% OF SLUM POPULATION
KENYA	NAIROBI	1984	959	23
	KISUMU	1984	163	73
	MOMBASA	1984	496	69
MOZAMBIQUE	MAPUTO	1985	750	60
	BEIRA	1985	250	33
TANZANIA	DAR-ES-SALAAM	1981	757	65
	TANGA	1978	103	60
ZAMBIA	LUSAKA	1981	650	50
	KITWE	1980	350	75
ZIMBABWE	HARARE	1982	656	25

Source: Syagga (1995)

Given the deteriorating housing situation, especially in the developing countries, the United Nations established a special organ to address the problem – the United Nations Centre for Human Settlements (UNCHS). This United Nations organ in conjunction with other bodies such as the World Bank has devised a series of policies and strategies by which the deteriorating housing situation of developing countries was to be addressed. The main thrust of these policies evolved from outright direct government intervention in the 1970s to the mid-1980s when the role of governments was downgraded to that of an enabling role (World Bank, 1993).

Thus, the role of governments in housing provision was seen in the light of a facilitator and coordinator of policy, where the necessary environment is created for private capital to flow into the housing sector. Such capital inflow could come in form of self-help housing or from the corporate sector through property investment corporations. In other words, the direct involvement of the government in housing provision is seen as having a crowding-out effect on the private sector. It was this thinking that underpinned the Global Shelter Strategy (GSS) initiative of the World Bank (World Bank, 1993; GSS, 1988), where the emphasis has been on enabling housing markets to work. As indicated above, the developing countries have not been able to implement these policies and succeed with them given the twin problems of inadequate financial capital and the rapid growth in population, especially in sub-Saharan Africa.

Table 3.3

Demographic Indicators: Estimates And Projections For SSA By Sub- Region & Country, 1990

SUBREGION/ COUNTRY	POPULATION ESTIMATE (MILLION)	BIRTH RATE (PER 000 OF POP.)	DEATH RATE (PER 000 OF POP.)	NATURAL INCREASE (ANNUAL %)	POPULATION DOUBLING TIME (YEARS)	PROJECTED POP. 2000 (MILLION)
E/RICA	199.0	47	17	3	23	272.8
ETHIOPIA	51.7	44	24	2	34	70.8
TANZANIA	26	51	14	3.7	19	36.5
KENYA	24.6	46	7	3.8	18	35.1
UGANDA	18	52	17	3.6	20	25.1
MOZAMBIQUE	15.7	45	19	2.7	26	20.4
SEYCHELLES	0.1	25	8	1.7	41	0.1
DJIBOUTI	0.4	47	18	3.0	23	0.6
CENRAL AFRICA	68.0	45	16	3.0	23	91.1
ZAIRE	36.6	47	14	3.3	21	50.3
CAMEROON	11.1	42	16	2.8	26	14.5
ANGOLA	8.5	47	20	2.7	26	11.1
SOA TOME/ PRINCIPE	0.1	36	9	2.7	25	0.2
W/AFRICA	205.7	47	17	3.0	23	279.3
NIGERIA	118.8	46	17	2.9	24	160.8
GHANA	15.0	44	13	3.1	22	20.4
COTE D'LVOIRE	12.6	50	14	3.7	19	18.5
CAPE VERDE	0.4	38	10	2.8	25	0.5
SIERRA LEONE	4.2	48	23	2.5	28	5.4
SOUTHERN AFRICA	44.9	36	9	2.7	26	58.7
LESOTHO	1.8	41	12	2.8	24	2.4
NAMIBIA	1.5	44	12	3.2	22	2.1
BOTSWANA	1.2	40	11	2.9	24	1.6
SWAZILAND	0.8	46	15	3.1	22	1.1
SOUTH AFRICA	39.6	35	8	2.7	26	51.5

SOURCES: Population Reference Bureau (1990); UN Economic Commission for Africa (1988)

Table 3.3 shows the phenomenal rates at which population is growing in sub-Sahara Africa, indicating the enormity of the housing problems, especially when housing demands outpace housing supply.

Furthermore, any hope of being able to arrest the problem in the medium to long term is dashed when the population structure for sub-Saharan Africa is considered.

Table 3.4

Demographic Indicators: Estimates &Projections For SSA By Subregion And Country, 1990 (Under15\ Over 65, Percentage Urban Population)

SUBREGION/ COUNTRY	% POPULATION UNDER 15/ OVER 65	LIFE EXPECTANCY AT BIRTH (YRS)	URBAN POPULATION %
E/AFRICA	47/3	50	18
ETHIOPIA	46/4	41	11
TANZANIA	49/2	53	19
KENYA	50/2	63	20
UGANDA	49/2	49	9
MOZAMBIQUE	44/3	47	19
SEYCHELLES	36/6	70	52
DJIBOUTI	46/3	47	78
C/AFRICA	45/3	50	37
ZAIRE	46/3	53	40
CAMEROON	44/3	50	42
ANGOLA	45/3	45	25
SOA TOME/ PRINCIPE	42/5	65	38
W/AFRICA	46/2	48	30
NIGERIA	45/2	48	31
GHANA	45/3	55	32
COTE D'LVOIRE	49/2	53	43
CAPE VERDE	42/5	61	27
SIERRA LEONE	44/3	41	28
SOUTHERN AFRICA	40/4	62	53
LESOTHO	43/4	56	17
NAMIBIA	45/3	56	51
BOTSWANA	46/3	59	22
SWAZILAND	47/2	50	26
SOUTH AFRICA	40/4	63	56

SOURCES: Population Reference Bureau (1990); UN Economic Commission for Africa (1988)

As indicated by Table 3.4, the implications for environmental sustainability from future demands on the biophysical environment is clearly demonstrated by the population under the age of 15 years of age, which stands at 48 percent of the total population. Viewed from a regional basis, Eastern Africa has a percentage of 47% of its population under 15

years, and 3% over 65, Central Africa has 45% and 3%, West Africa, 46 and 2% and Southern Africa, 40 and 4% respectively (Population Reference Bureau, 1990; UN Economic Commission for Africa, 1988). This in economic terms implies a high dependency rate, which has serious implications for per-capita income and the ability to replicate housing infrastructure to the segment of the population currently without shelter (Ebohon, 1993; Oucho, 1992).

Furthermore, another worrying population characteristics are their spatial distribution.

Table 3.5

Percentage Of Population That Is Urban In Africa, Latin- America And Asia (1920 –2000)

YEAR	AFRICA	LATIN-AMERICA	ASIA
1920	7.0	22.4	8.8
1930	9.2	27.9	10.3
1940	10.4	30.8	12.9
1950	11.4	40.6	15.7
1960	18.2	49.4	20.8
1970	22.9	57.4	23.8
1980	28.9	64.8	27.4
1990	35.7	70.7	32.3
2000	42.5	75.2	38.9

Source: Adepoju (1983)

The significance of the contents of Tables 3.1 to 3.5 as far housing is concerned lies in

the fact that there is a close relationship running through from housing need, population growth, and urbanisation (GSS, 1988). Given the spatial population structure, it is hardly surprising that existing housing infrastructure in many cities of the developing, which remained static has not been unable to cope with demand (Bhatia, 1994; Abloh, 1976). As a result, it is not uncommon to find 7 people sharing a room in the shanty- towns of Sub-Saharan Africa. This scenario is validated by the experience of Kampala in Uganda, where urban population is growing at the rate of 4.8 percent annually but experiencing massive housing deficits expected to reach 279 500 units by 2006 (Ebohon, 1996).

The linking of the quality of life with the biophysical environment under the United Nation's Agenda 21 declaration in 1992 ushered in a new urgency to arrest the deteriorating built environment in developing countries (Ebohon, 1998; Pugh, 1997; GSS, 1988). The implication being that apart from the direct environmental benefits from reducing resource intensity of housing construction, a decent housing and functional built environment are necessary prerequisites to environmental sustainability. The following analysis of South Africa housing sector is discussed around these themes and perspectives, which have been identified above.

3.3 South Africa's Housing Situation

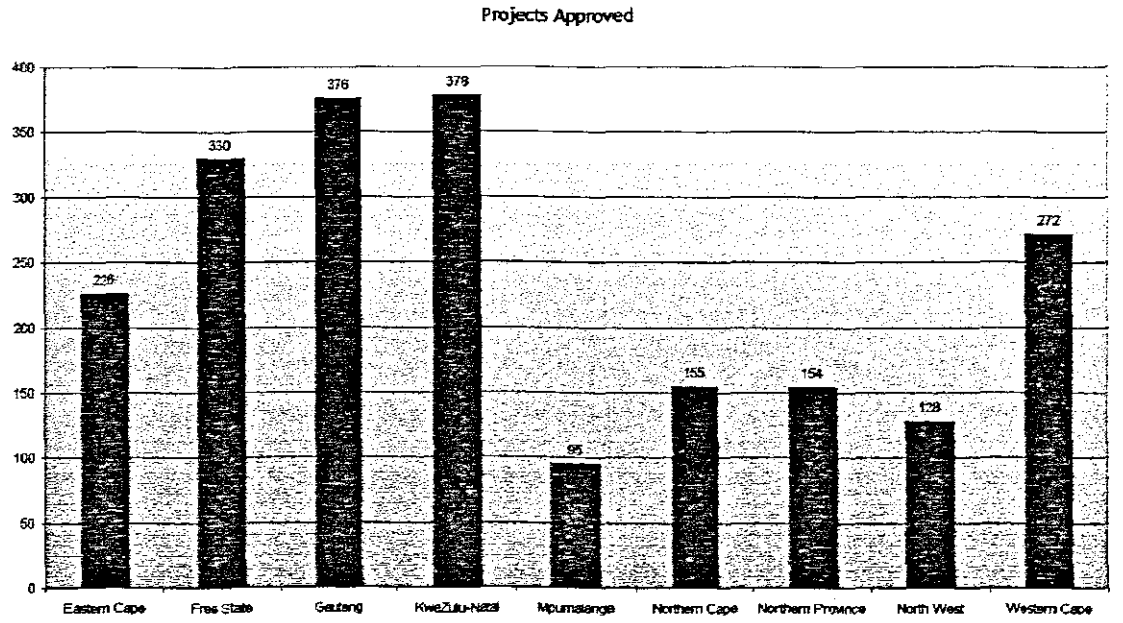
Along with international trends, South Africa has huge housing problems. However, its housing problems have been compounded by its historical past and the legacy of that era still persist with regards to housing and perhaps will remain so for the foreseeable future. Thus, it is hardly surprising that South Africa's housing sector is characterised by

shortages and huge backlogs as well as deterioration in existing stocks (Government of National Unity, 1995). However, apart from the effects of the deliberate policies of previous governments to use housing as a vehicle for implementing its socio-economic policies (Innes, 1986), extensive bureaucracy, overlapping and duplication of roles have combined to undermine housing production and delivery efforts (Government of National Unity, 1995). While this may be so, the impact of its historical past on the current housing situation cannot be ignored where the majority of the population was excluded from mainstream socio-economic activities, denying access to housing and other facilities (Dept of National Housing, South Africa, 1995).

However, existing housing conditions in South Africa reveal a total stock of 4.9 million housing units in 1995 of which 3.4 million were formal houses and 1.5 million informal housing units, which leaves a backlog of 1.5 million houses (Dept of National Housing, South Africa, 1995). Aside, it is further estimated that there are 720, 000 serviced sites in urban areas requiring upgrading along with existing public, private, and grey sector hostel accommodation for 450, 000 South Africans. The annual population growth rates of 2.27 percent and rising household formation complicate the housing situation further, as housing production and delivery lag behind, forcing housing backlog to rise annually by 178, 000 units (Dept of National Housing, South Africa, 1995). Despite the production and delivery of 1.13 million housing units since 1994, housing 5 million people, housing backlog has increased to between 2 to 3 million housing units and a total number of people needing housing has increased to 7.5 million people (Dept of National Housing, South Africa, 2000). Nevertheless, Figure 3.1 indicates that the government is approving

new housing projects across the provinces where the differences in the number of projects commissioned in the provinces also reflect housing needs brought about mainly by population pressure and household formation.

Figure 3.1



Source: Department of Housing Statistics

There is a huge disparity among the population relative to housing needs. The more worrying phenomenon about the housing situation is the great disparity in the housing statistics whereby Blacks disproportionately account for those without shelters.

Table 3.6 Backlog in Housing (1990)

Race	Units/Houses Required	Unit/Houses Required per Annum
Asians	3000	3000
Blacks	124,8000	179,000
Coloureds	43,000	10,000
Whites	1000	6000

Source: South Africa Housing Council, (1992)

Although about 1.3 million low-cost houses have been built and delivered since 1994, Blacks remain the group with the highest housing needs in South Africa, which poses several dilemmas and challenges, to satisfying total housing demands.

The first of these challenges derive from the fact that the Black population also endures the highest rates of unemployment in South Africa as shown in Table 3.7.

Table 3.7 Unemployment by Population Group (Ages 15-65)

(Millions) UNEMPLOYED	African/ Black	Coloureds	Indian/ Asian	White	Unspecified /Others	Total
MALE	1.811	.142	.029	.046	.013	2.041
FEMALE	2.395	.158	.021	.043	.014	2.631
TOTAL	**4.206**	**.300**	**.500**	**.089**	**.027**	**5.122**

Source: Population:- Revised CSS estimates for 1996 / Poverty :- 1994 CSS / Unemployment: 1995 Household Survey WESGRO (1998)

Evidently from Table 3.7, 82 percent of the Black population are unemployment and the table further shows that this figure is even higher when disaggregated. Amongst the female population, the rate of unemployment is more than 91 percent while that for the male population is 88 percent. This has enormous implications for housing affordability

and limits the scope for housing production and delivery, especially given the higher percentage of households headed by the female population.

The second challenge posed by the huge housing backlogs for the Black population concerns the fact that the unfolding rapid population growth in South Africa occurs within the Black population. Table 3.8 shows the population forecast for the Black population from the 1990 base year for the year 2000.

Table 3.8 Population forecast for 2000

RACE	1990	2000
BLACK	28 249	37 280
WHITE	5 471	5 480
COLOURED	3 320	3 802
ASIAN	1 012	1 177
TOTALS	**38 052**	**47 739**

Source: Development Bank of South Africa, Urban Foundation, South African Housing Advisory Council, 1992

Evidently, the forecast for the Black population is not only higher than those of the other groups, but almost doubled the 1990 figure and shows an increase of 76 percent. Combining this with other development indicators, especially at the provincial levels demonstrates the complexity of South Africa's housing problems and how these problems interface with other wider socio-economic factors.

Table 3.9 Provincial Development Indicators

PROVINCE	POPULATION %	POPULATION MILLION	POVERTY IN %	UNEMPLOYMENT % (1995)	HOUSING SHORTAGE '000
E / CAPE	15,6	5,9	62	41,4	230
FREE STATE	6,6	2,5	45	26,1	115
GAUTENG	19,0	7,2	21	20,9	790
KWAZULU NATAL	20,4	7,7	49	33,1	385
MPUMALANGA	6,9	2,6	43	33,4	60
NORTH-WEST	7,9	3,0	41	32,8	225
N / CAPE	1,9	0,7	46	27,2	12
N / PROVINCE	10,8	4,1	68	41,0	100
W / CAPE	**10,9**	**4,1**	**18**	**17,5**	**185**
RSA	100,0	37,8	42.2	29,3	2,1 mil

***Sources:* Population: - Revised CSS estimates for 1996 / Poverty: 1994 CSS / Unemployment: 1995 Household Survey WESGRO (1998)**

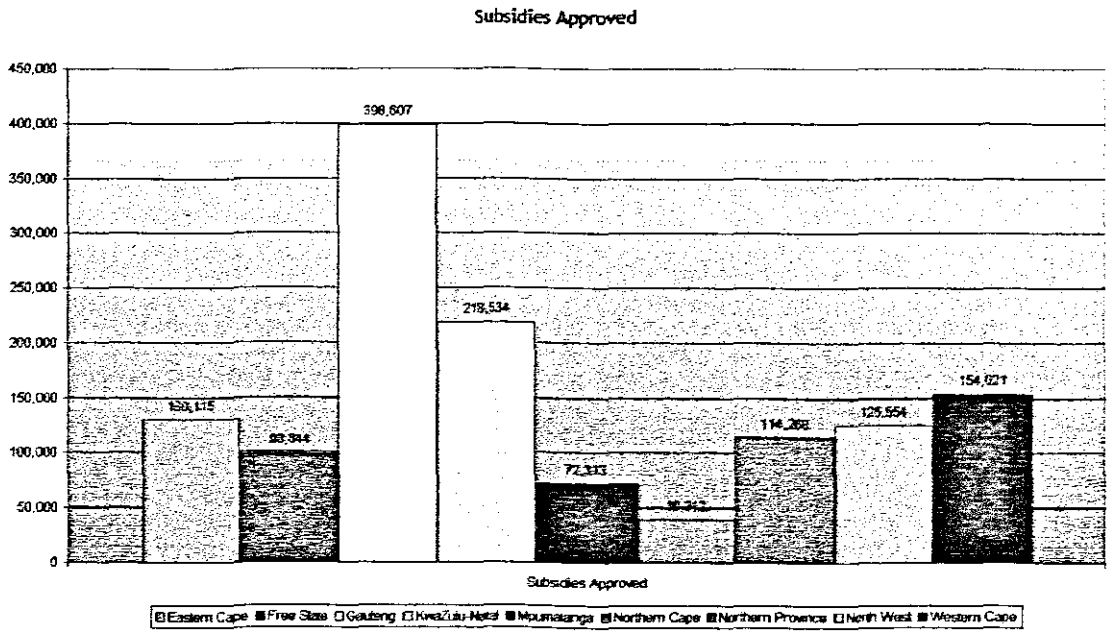
As is shown in Table 3.9, a global picture of housing shortages in South Africa is presented, which shows population density, population distribution across provinces, while at the same time highlighting the levels of unemployment and poverty. It thus shows that housing needs vary across provinces with the relatively poorer provinces experiencing greater housing needs. Population distribution by province indicates that Kwazulu Natal and Gauteng have the highest population, with 7.7 and 7.2 million people respectively. The particular case of Gauteng was expected, given the levels of industrial and commercial activities, explaining the relatively low levels of unemployment endured by the province. However, the implication has been the high rates of rural-urban migration as well as migrations from neighboring African States, which is why it ranks as the province with the highest housing needs. In the case of Kwazulu Natal, the unemployment rate is 20.9 percent but experiences a much higher rate of poverty.

This pattern is repeated in Northern Province and Eastern Cape with high levels of

unemployment and poverty. Indeed, apart from Western Cape, all other provinces exhibit similar socio-economic characteristics.

The implication of the above analysis is that an increasing proportion of the population would require full housing subsidy, which numbers almost 16 million people (S.A Housing Advisory Council, 1992; Housing subsidy scheme, 1995). If an average family size of 5 per household were adopted as an ideal household size, 3.2 million households would need housing subsidy.

Figure 3.2



Source: Department of Housing Statistics.

Figure 3.2 clearly indicates the number of subsidies that have been approved by the government. As expected Gauteng accounts for a huge proportion of the subsidies

granted mainly because of the huge population influx from other parts of the country, which also explains the proportion accounted for by Kwazulu Natal.

Table 3.10 Subsidy Requirements by Households October 1995

Category	Blacks %	Coloureds %	Indians %	Whites %	CMA %	South Africa %
R0-R800	59	36	20	11	37	55
R801-R1070	12	8	7	4	9	6
R1071-R2500	20	43	44	29	34	23
R2501-R3500	5	8	12	13	8	6
R3501-R5000	2	3	14	21	6	5
R5001-R8000	2	1	4	14	4	3
R8000 +	1	1	0	10	2	2
Total	100	100	100	100	100	100

Source: Central Statistical Services, (1996), as sited in Cape Metro: Contextual Information (CMC), (1999a)

Table 3.10 attests to the discussions earlier of the prevalence of poverty in South Africa. As can be observed, 55 percent of the total population fall within the lowest income bracket, and particularly affected is the Black population where the percentage in the lowest-income category is above the national average.

The challenge of producing and delivering the estimated annual 200 000 new housing units together with another 178, 000 units required to meet demands and accommodate the huge backlogs at affordable prices remain the real challenge. This is particularly the case relative to competing demands for limited government resources.

A bigger challenge is to satisfy such huge housing demands with minimum impact on the biophysical environment.

3.4 South African Housing Policy

The manner in which any particular country or culture defines shelter has a profound bearing and influence on its policy. In the case of South Africa the vision expressed in its national housing policy document is all embracing. It sets out to ensure that "habitable, stable and sustainable public and private residential environments are created for viable households and communities." The importance attached to the environment is very much in line with the United Nations Agenda 21 under which the concept of environmental sustainability has been extended to reflect the fact the a house transcends its physical attributes. Accordingly, a house may not satisfy the strict criteria of environmental sustainability if it is socially unsustainable. In other words, the built environment in addition to environmental sustainability must also be socially sustainable, creating an enabling environment for cohesive communities to exist.

Thus, a house can hardly be defined as sustainable if it remains unaffordable as the concept of affordability transcends initial housing costs to include running and maintenance costs as well as living expenses, which are key considerations for effective and efficient housing functionality (Aboutorabi, *et al.*, 2000). Thus, affordability is influenced by several factors such as distance from the workplace or employment opportunities, ill health due to poor housing conditions such as indoor pollution, overcrowding, poor sanitation and general unhealthy living conditions (Whiteside *et al*, 1995; Adebayo, *et al.* 2000).

The main thrust of the government's new housing policy is to enable individuals and communities to satisfy their housing needs. This involves ensuring that appropriate

institutions are in place to facilitate the enabling strategy that would allow private capital inflow to the housing sector (Dept of National Housing, South Africa, 2000). Underpinning the strategy is to strive for higher economic growth that would allow for expansion in the labour market so that aggregate income levels could be raised. The rationale is that rising income would allow more individuals to meet their housing demands, allowing emphasis to be placed on meeting the housing needs of those to whom housing remain unaffordable. However, given the fact that more than 40,370 households in the country earn a joint income of less than R800 per month, it would require massive employment opportunities in order to raise current household income levels.

However, the current reality of high unemployment in South Africa indicates that housing subsidy would remain the most realistic means of effecting housing affordability in South Africa for those out of work. Indeed, the evidence in Table 3.10 shows that even those at work would also require housing subsidy because of the huge percentage of the total population that fall into the low-income bracket. This is particularly the case where housing finance is probably the largest single investment individuals are likely to make in their life time, especially those within the low-income bracket. Thus, subsidy remains a permanent feature of South Africa's housing policy.

The government has the policy choice of channelling such subsidies through consumers or producers. Consumer subsidy is considered relatively more efficient given that it allows consumers to shop around and 'vote with their feet', forcing competition among producers (Ministry Of Housing, 1996). The draw back is ensuring that the amount is

spent on housing and not other goods. Similarly, the government has the option of channelling subsidies through producers, which in this case are property developers (Ministry Of Housing, 1996). While this ensures that houses are delivered, it nevertheless has the drawback of consumers having to accept what is provided and not necessarily what the consumer wants.

Nevertheless, the government has applied both subsidy types whereby subsidies have been given to producers in form of grants as well as to consumers in form of cash but the latter type of subsidy predominates. The subsidy programmes of the government include the following:

- ownership subsidies that allows individuals to own their own houses
- collective ownership subsidies aimed at facilitating collective housing, which would be accessed by individuals
- social housing subsidies aimed at social housing institutions
- rental subsidies for institutions that supply affordable and subsidised housing to the rental market
- subsidies targeted at the previously disadvantaged communities

However, the levels of subsidies are measured against the real fiscal constraints faced by the government but are sufficiently flexible to serve a wide range of tenure and housing delivery choices. Nevertheless, Table 3.15 gives a clear indication of the amount of subsidies that would be necessary to effect the housing policy objectives of the government given the level of poverty. Evident from this table is the proportion of households headed by female and supported by single income, which is an indication of poverty. Furthermore, the subsidy criteria of the government would indicate that about 90 percent of the population would qualify for either full or part of the subsidies offered (Central Statistical Services, 1996).

Table 3.11 Subsidy Categories per Monthly Income

Monthly beneficiary income	Subsidy amount
R0 to R800	R15,000
R801 to R1, 500	R12, 500
R1,501 to R2, 500	R9, 500
R2, 501 to R3, 500	R5, 000

Source: Department of Housing: Annual Report, (1997)

According to the government, every household earning R3 500 or less a month qualifies for a subsidy unless they have secured a service site in the past on the State's housing assistance scheme. Even then, they still qualify for subsidies if income to that particular household is or less than R1 500.

A glance at these policies would show that they are short-term intervention measures by the government. Thus, the government has other long-term intervention strategies where the mobolisation of appropriate credit facilities, rearrangement of housing institutions, facilitating the speedy release of land, and aboveall the stabalisation of the housing environment are considered an overriding priority.

However, these policies have been the subject of several criticisms, especially their manifestations on the ground with regards to the slow pace of housing construction and delivery, the difficulties associated with accessing subsidies, housing quality, and on environmental grounds. In particular, government subsidies have been severely criticised for its inadequacy relative to government objectives of delivery of "habitable, stable and sustainable public and private residential environments for viable households and communities." This is particularly relavant when such subsidies assume that recipients would be able to access further funding from the capital market, which has been criticised as unrealistic for appropriateness and affordability (Adebayo, *et al.* 2000).

Similarly and perhaps a more devastating assault on the government's environmental sustainability objectives, with regards to housing production and delivery within the confines of sustainable development, has been made (Adebayo, *et al.* 2000).
Adebayo, *et al.* (2000) assert that cost savings rather design and quality, and as a result architectural value and aesthetics have been lost together with "a sense of identity" for residents. Similarly and in a more detailed study to date, low-cost housing has been found inadequate with regards to two distinct measurements of environmental sustainability,

including technical and biophysical facets of sustainability (Walker, *et al.* 2000). The first sets of criteria applied under the technical facet include factors such as quality, durability, and indoor comfort. Under biophysical considerations, location and the energy and water efficiency of these units was investigated. The conclusion was that in both categories, the low-cost housing units being built and investigated failed to satisfy the sustainability indicators constructed for the study.

Despite these criticisms the genuine efforts and sincerity of the South African government to meet the housing needs of its people through its enabling housing policies is in no doubt. However, the real challenge is whether housing needs can be met with minimal or zero costs to the biophysical environment and at the same time fulfil its social sustainability obligations. This challenge is considered in chapter 4 where the biophysical environment is considered with particular attention to physical housing units, the current mode of housing provision versa-visa intensive development, and the attendant raw-material implications of such development.

3.19 Conclusion

This chapter has considered the housing problems of South Africa within a global and regional context. While South Africa's past contributed to its housing problems, it cannot be denied that concerted efforts are now being made to redress the housing issues. However, the process is hampered by rapid population growth, high rates of unemployment, increasing poverty, and competing demand for limited government revenue. This has not stopped the government from delivery of well over a million low-

cost housing units since 1994. However, there is a need for the government to recognise the impact of housing provisions on the biophysical environment and seek other ways of enhancing housing affordability. These two objectives can be achieved almost simultaneously amongst other measures by encouraging the recycling and reuse of construction waste, while reducing building costs also has the added advantage of minimising natural resource intensity of construction activities.

CHAPTER 4:

SOUTH AFRICA'S BIOPHYSICAL ENVIRONMENT AND HOUSING PROVISIONS

4.1 Introduction

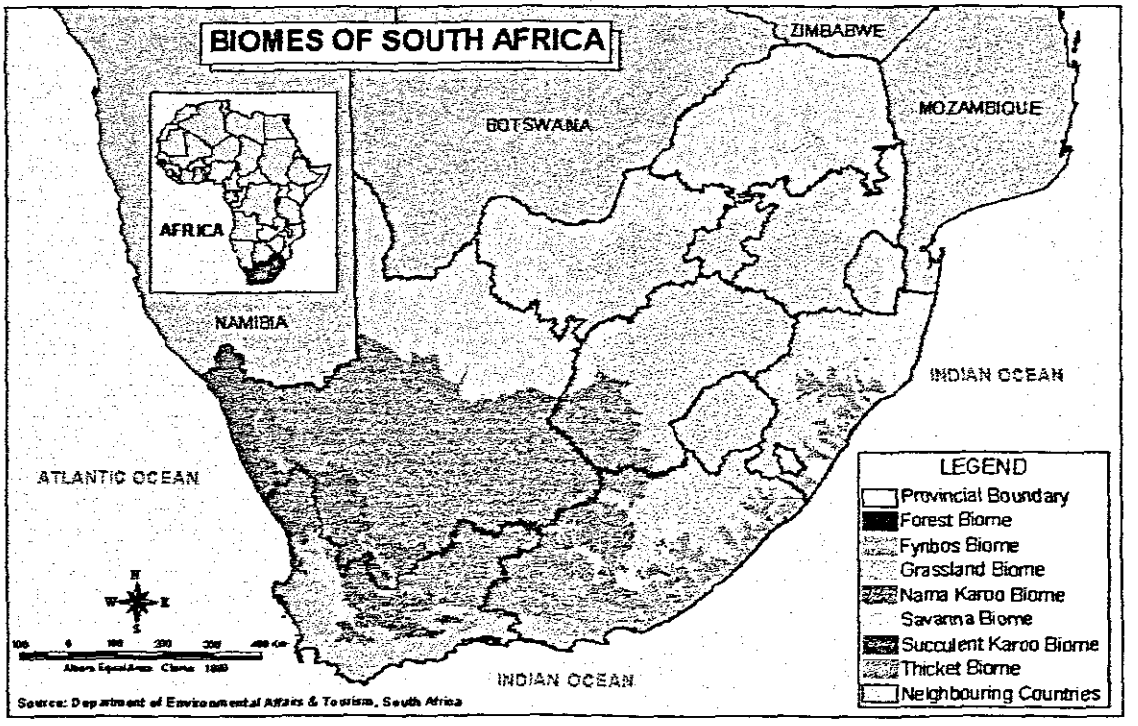
In chapter 3, environmental sustainability featured prominently in South Africa's housing white paper (Dept of National Housing, South Africa, 2000). As also indicated, efforts have been made to empirically validate the environmental credentials of low-cost houses, of which over one million has been built, against biophysical and social sustainability indicators (Walker, *et al.* 2000, Adebayo *et al.* 2000). While the debates about the extent to which these sustainable attributes are currently observed in South Africa's built environment sector continues, the impact of housing construction on the biophysical environment of South Africa is best appreciated by considering the state of South Africa's biophysical environment itself.

This allows the focus on the impact of material input to housing construction on South Africa's biophysical environment. The main focus in establishing the impact of materials use on the environment is to emphasise the finite and non-renewable nature of construction materials, enhancing the argument for recycling and reuse of construction materials

4.2 South Africa's Biophysical Environment.

In terms of biological diversity, South Africa ranked third amongst countries with the greatest biological diversity.

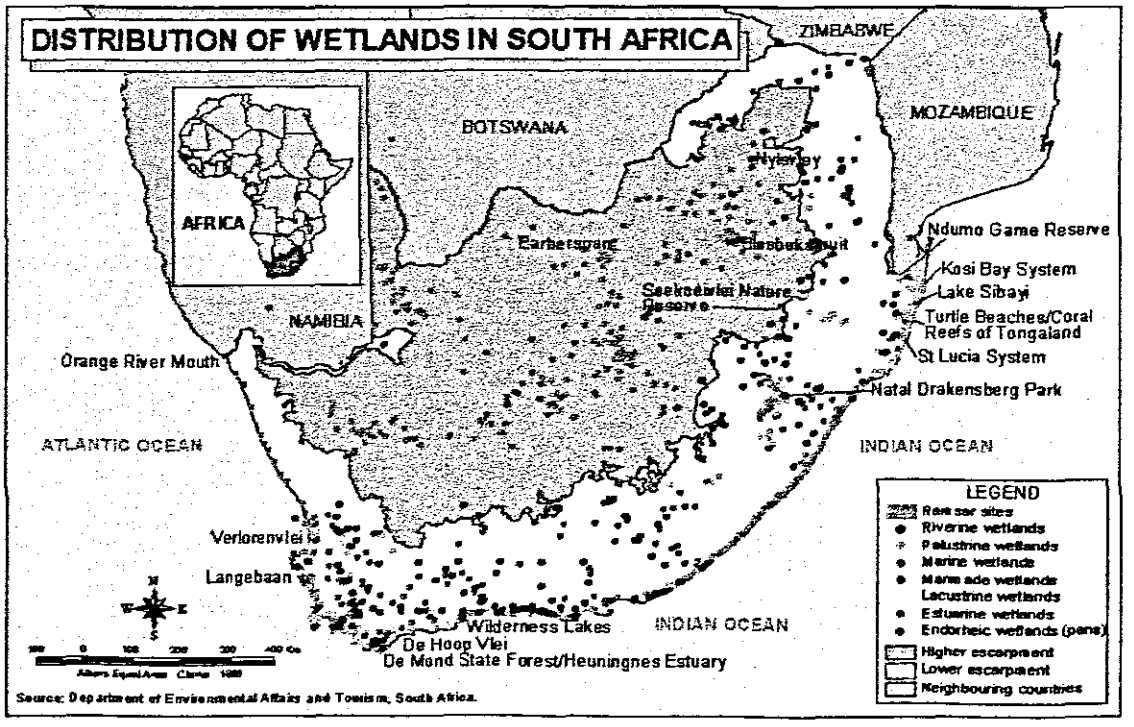
Figure 4.1



Source: Department of Environmental Affairs and Tourism, South Africa.

Figure 4.1 indicates the huge biodiversity of South Africa, which is habitat to many of the world floras and faunas. It has 7.5 percent of the world's vascular plants, 5.8 percent of the world's mammal species, 8 percent of the world's bird species, 4.6 percent of the world's reptile species, 16 percent of marine fish species and 5.5 percent of the world's recorded insect species. This is attributable to the extensive range of climatic, geological, soil and landscape forms of the country, especially the extensive wetlands, which is habitat to different varieties of flora and fauna as shown in Figure 4.2.

Figure 4.2

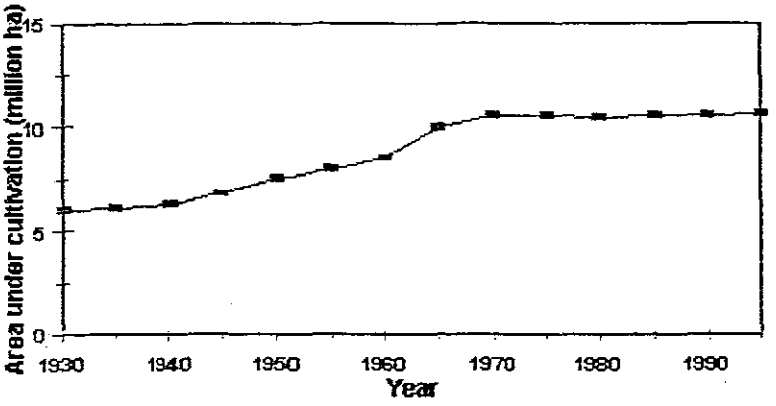


Source: Department of Environmental Affairs and Tourism, South Africa.

However, many of these species are threatened with extinction, and the rates of extinction are high in South Africa by global standards owing to the increasing proportion of land area devoted to agriculture, including animal husbandry. As figure 4.3 indicates, a huge proportion of land has been converted to agriculture since the 1930s.

Figure 4.3

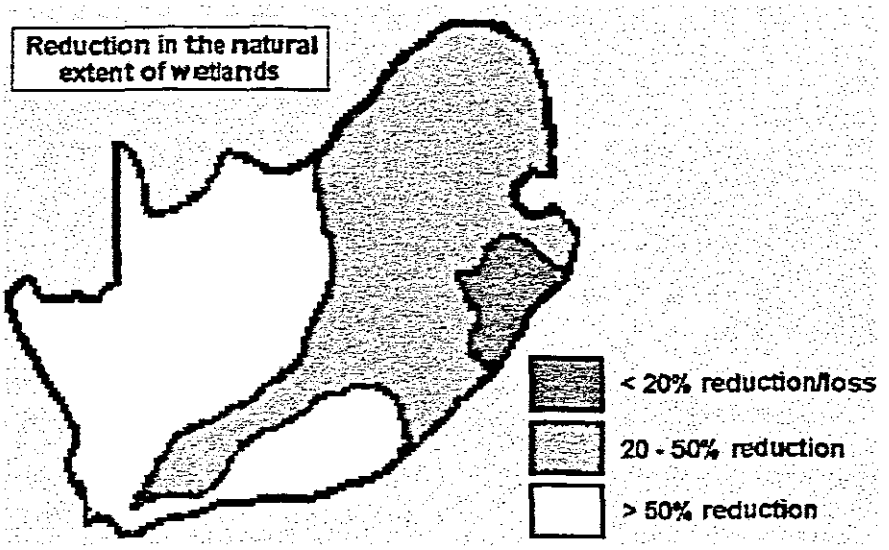
Natural Vegetation Converted into Agriculture



Source: Department of Environmental Affairs and Tourism, South Africa. (2000)

Currently, only 10 percent of South Africa's land are conserved while a huge 86 percent is devoted to agriculture.

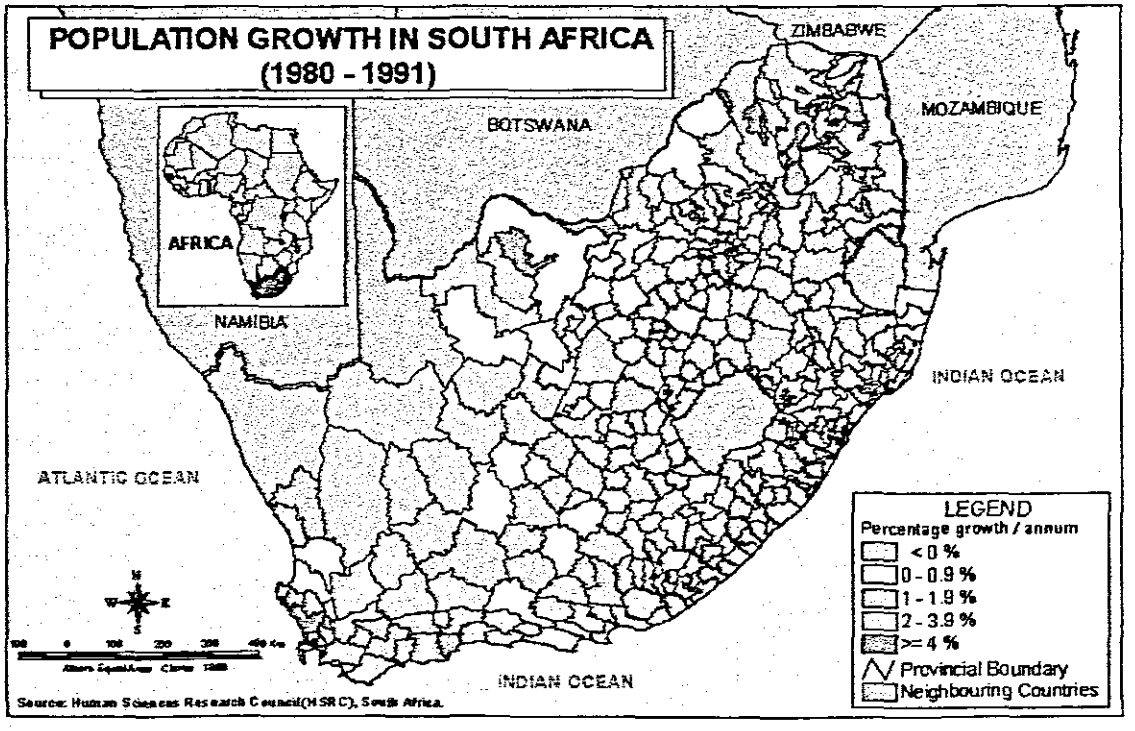
Figure 4.3.1



Source: Department of Environmental Affairs and Tourism, South Africa. (20000

The main threats have come as a result of the rapid growth experienced in population, which in turn has fuelled urbanisation while at the same time intensifying agricultural production. Similarly, the industrialisation process has also been intensified in order to meet the demands for food, energy, and other basic commodities.

Figure 4.4



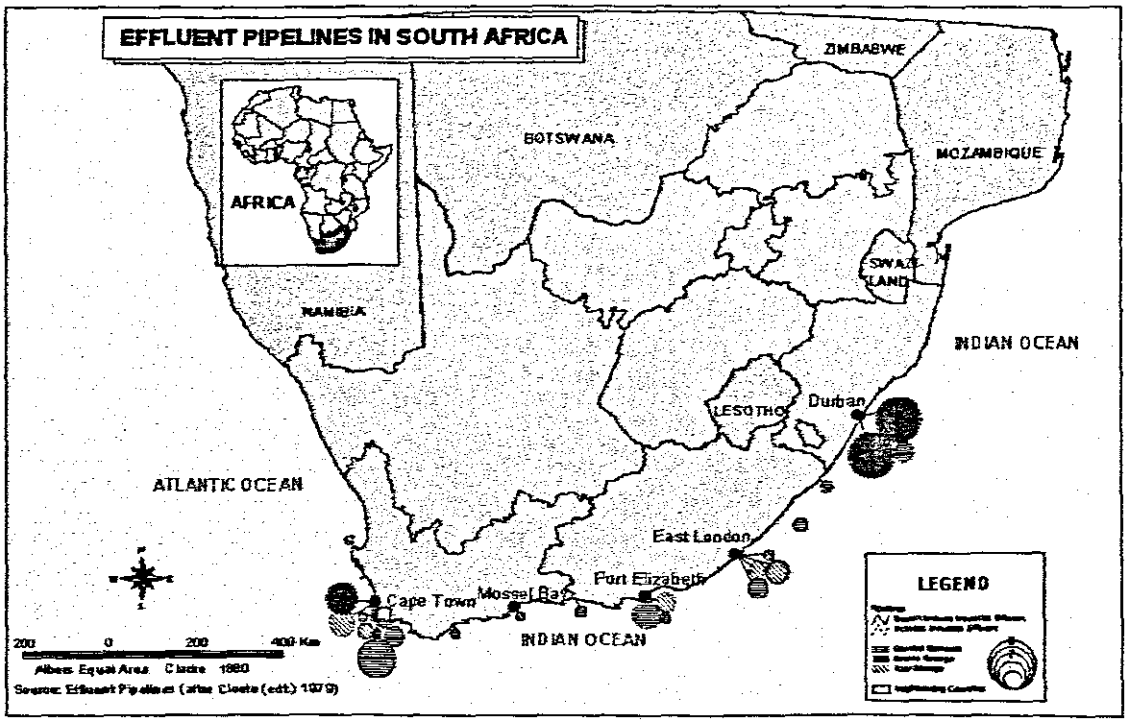
Source: Human Sciences Research Council, (2000)

As shown in figure 4.4, population has grown between 1980 and 1991 but what is significant is the rate of growth around the most environmentally sensitive ecosystems where more than 4 percent growth has been experienced. Thus, population growth drives agricultural expansion to meet food demands, areas of natural habitat are converted to

other land uses with adverse impacts on the number and types of species following the inevitable deforestation and bush encroachment. These processes change the vegetation structure, and the type and number of animals that can be supported. Collection of plant material for the medicinal and horticultural trades, reduces the abundance of certain species in the wild, and has led to extinction of some species.

As a consequence of such accelerated development, large amounts of waste and pollution are generated, putting huge pressure on the environment in terms of suitable waste disposal sites, pollution, and changes to the atmospheric composition, with obvious consequences for climate stability.

Figure 4.5



Source: Department of Environmental Affairs and Tourism, South Africa. (2000)

Indicated in Figure 4.5 is the huge amount effluent already discharged into coastal waters most of which are untreated.

Changes to the climate as well as climatic conditions have become inevitable owing to the ongoing alteration to the ecosystem, some of which have proved irreversible as can be seen in the deteriorating state of the stratosphere owing to atmospheric pollution. Indeed, atmospheric pollution has the potential to alter the distribution of species and communities as a result of the likely changes to adaptations and conditions of organisms and species. With so little of South Africa remaining natural habitat, it may be difficult for organisms to move to more suitable areas, and extinctions will become more frequent.

Thus, the impact on population pressure on the natural environment of South Africa is enormous and no where has such demand manifested other than fresh water demands. This natural resource of clean fresh water is undergoing rapid depletion as more than half of the county's wetlands resources have been lost to agriculture and dams, creating a situation where South Africa now looks to neighbouring countries to meet its increasing water demands. As Table 4.1 indicates, future intensity of natural resource consumption such as water demands is projected to double and rise by 52 percent by 2030. Similarly, the built environment sector is the sector showing the highest expected increase in water demand by 2030.

Table 4.1 Present and Projected Water Demand

User Group	% Contribution to GDP	Volume use, 1996 (million cubic meters per year	Predicted volume use, 2030 (million cubic meters per year)	% Increase
Urban & domestic	-	2 171	6 936	219.5
Mining & industrial	37	1 598	3 380	111.5
Irrigation & afforestation	6	12 344	15 874	28.6
Environmental	-	3 932	4 225	7.5
Total	-	**20 045**	**30 415**	**51.7**

Source: Department of Environmental Affairs and Tourism, South Africa (2000)

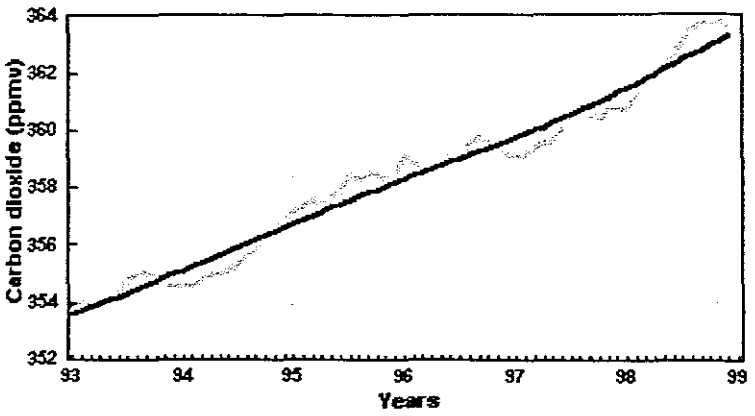
Thus, the association between South Africa's population growth and the huge burden on its biophysical environment and is clearly evident from this analysis. However, what this goes to show is that as population growth accelerates and fundamental changes to its structure occurs, South Africa's biophysical pressure is going to come under increasing pressure.

Thus, manifestations of changes to the population structure such as the likely increases in household formation would have enormous implications for South Africa's biophysical environment. Nevertheless, the nature and intensity of such implications hinges on lifestyles and no where has such lifestyles manifest most other than within the built environment with regards to housing design, spatial planning, and housing choice between intensive and non-intensive development, which has enormous implications for land use.

4.3 South Africa' Climatic and Atmospheric Environment

South Africa is widely acknowledged as a very climatically sensitive country because of the climatic sensitivity of its agricultural sector. Although the levels of greenhouse emissions are within guidelines, there are occasions, mainly in urban South Africa, when climatic conditions have deteriorated owing to intense energy consumption and industrial activities.

Figure 4.6 Trends in Atmospheric Concentration of CO_2



Source: Department of Environmental Affairs and Tourism, South Africa (2000)

In South Africa, the energy sector for example is the main source of carbon dioxide (CO_2) and sulphur dioxide (SO_2) emissions. Transport is another source of greenhouse gas emissions, contributing 44 percent of total nitric oxide emissions as well total volatile organic emissions (VOC). The incidence of these gases during sunlight results in petrochemical smog, which is toxic to humans, plants, and animals. Thus, with carbon dioxide concentration increasing by about 0.6 percent annually while tropospheric methane concentration having increased by 8.3 percent between 1983 to 1998, South

Africa's climatic conditions are likely to deteriorate further with increases in the variables that are implicated.

4.4 Sensitivity of South Africa's Biophysical Environment to Housing Construction

The very definition of housing as a variety of processes through which habitable, stable and sustainable public and private residential environments are created for viable households and communities attests to the relationship between housing as a product and the biophysical environment in which it must exist. This acknowledges that the environment within which a house is situated is as important as the house itself in satisfying the needs and requirements of the occupants. Thus, environmental issues are inherently linked with quality of life. In other words, environmentally sound human settlements should provide good air quality, ensure that housing is well located and is energy and water efficient and planting provides green "lungs' or even food security.

Land development and the spatial planning are crucial to the housing process and landuse in general, which in housing construction, is very significant to the discussion of the sensitivity of South Africa's biophysical environment. This is mainly due to the natural resource intensity of construction activities on the one hand, while on the other, the phenomenonal growth in population and the attendant implications for shelter provisions. Housing and human settlement in general has another significance to the biophysical environment because of the widely acknowledged fact that 75 percent of environmentally degradable factors, most of which are comprised of greenhouse gas emissions originate within the built environment. Thus, the way buildings are designed, the material inputs to

building construction, and the amount of land devoted to shelter all have significant implications for the biophysical environment (Ebohon, 1996).

As already indicated in chapter two there is huge energy embodied in construction material during manufacturing on the one hand, the huge chemical effluents that are also discharged on the other. Thus, this would indicate that recycling and reuse of construction wastes would have enormous impact on environmental sustainability through reductions in the use of new construction materials. Given that such a move also has the potential for enhancing social sustainability, especially affordability, recycling and reuse of construction wastes depicts a win-win scenario. First, it is absolutely crucial to consider types of low-cost housing designs, material inputs, and layout in order that the extent to which they are environmentally sustainable could be ascertained.

4.5 Environmental and physical characteristics of low-cost housing in South Africa

The evaluation of environmental characteristics of low-cost housing in South Africa can begin by first considering their locations, the size of these houses and the urban form in general. First, Figures 4.7 depicts a typical low-cost housing site while figure 4.8 to 4.11 depict the typical low-cost constructions in South Africa.

Figure 4.7 A typical site plan for low-cost housing in South Africa

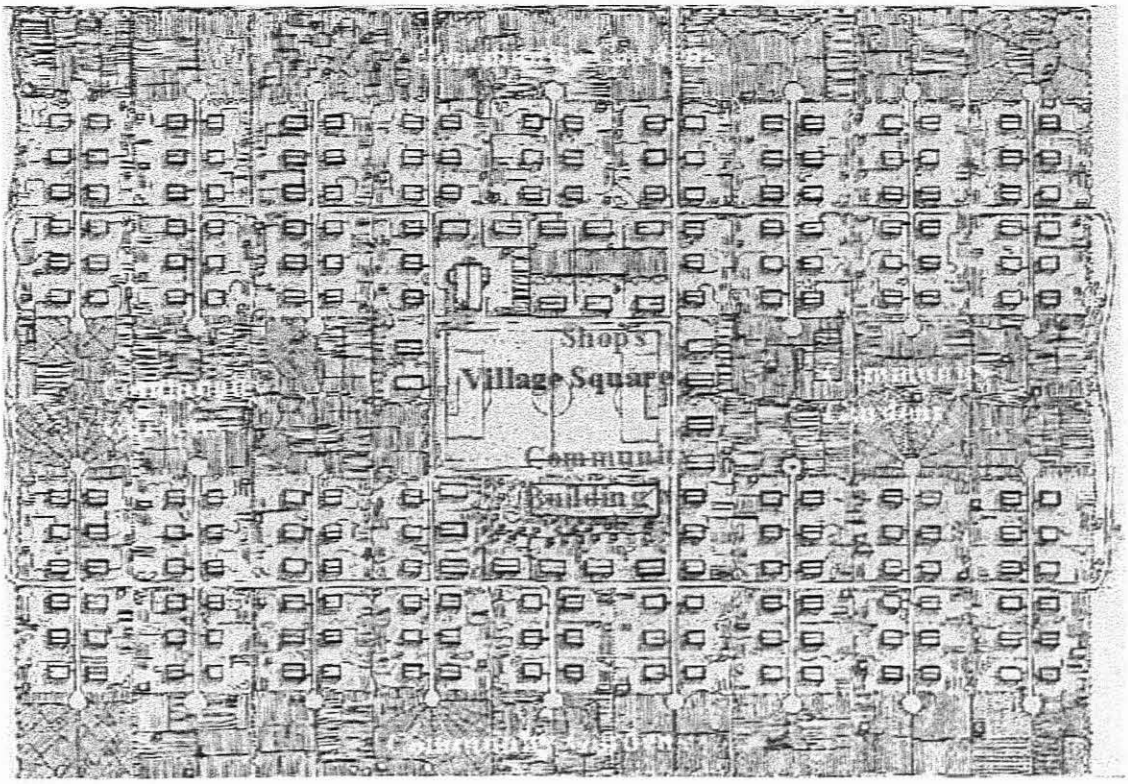


Figure 4.8 Typical Low-cost Housing Development/s

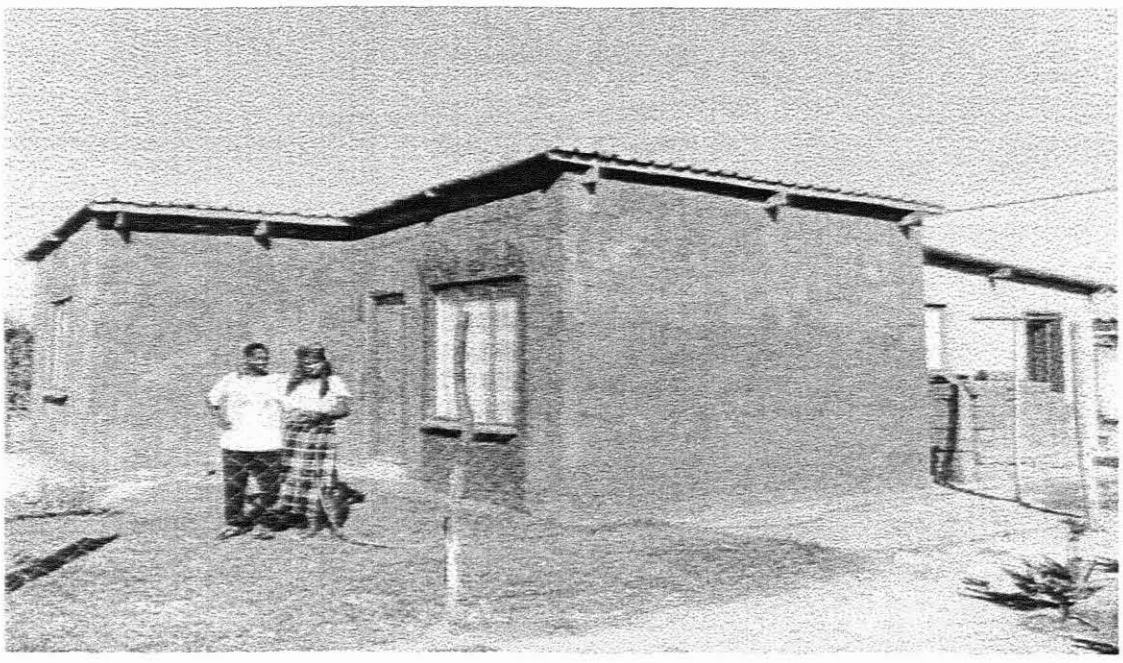


Figure 4.9

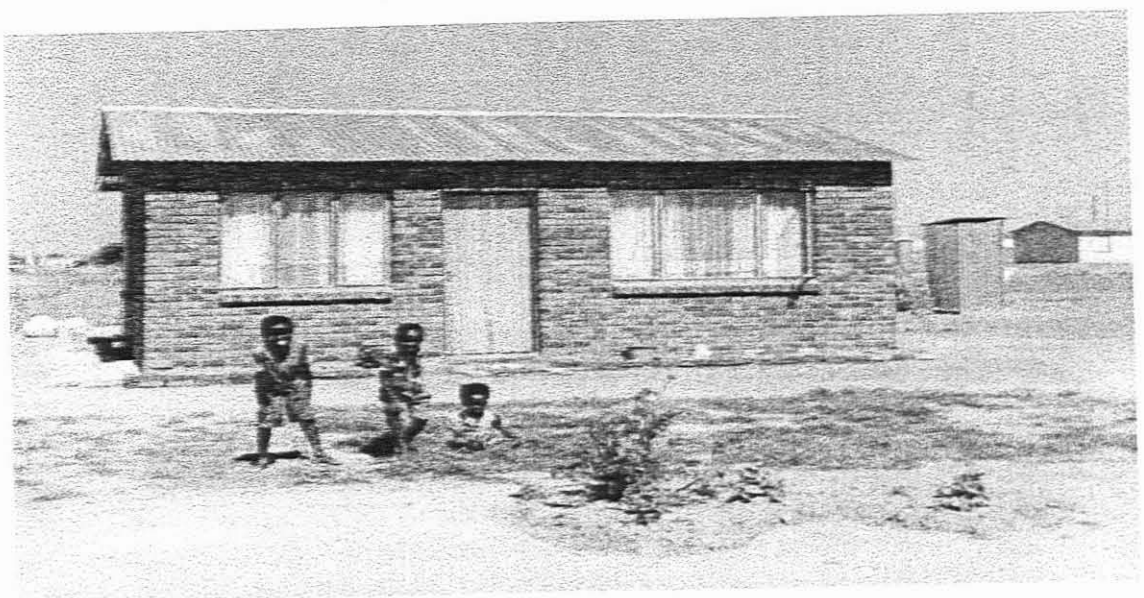


Figure 4.10

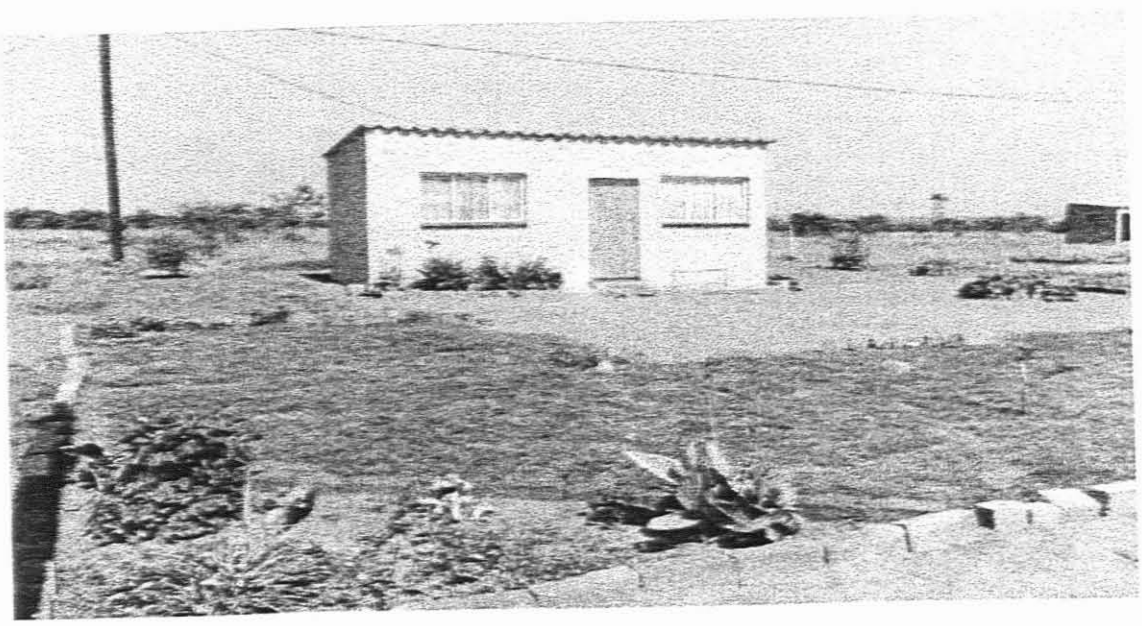


Figure 4.7 represents a typical low-cost housing site in South Africa, and as can be seen, they usually are on a huge expanse of land hewed out of greenfields and usually located away from centers of economic activities, forcing workers to travel long distances to work. Location has huge significance with regards to environmental sustainability, especially where greenfield sites are preferred to 'brownfield' sites for housing development on the one hand, and on the other, where such locations are too distant from the work place or areas of economic activities (Adebayo, *et al.* 2000). The reason has been blamed on the housing delivery policy framework of the government. As discussed above, such a practice involves massive loss of biodiversity, which is particularly the case when low-density detached housing units are favoured to intensive and high-density development. This has enormous implications for the proportion of land devoted to housing construction, which is especially the case with rapid population growth and the attendant household formation.

Similarly, there is an added huge implication for transport energy consumption and vehicular emission and pollution by virtue of the fact that the greensites available are usually very distant from economic activities. As already indicated above, the transport sector is a major source of greenhouse gas emissions, contributing 44 percent of total nitric oxide emissions as well 44 percent of the total volatile organic emissions (VOE) in South Africa. In terms of social sustainability, especially affordability, increased distance from work and from areas of economic activities generally imposes huge financial and social constraints on households. Households in low-cost housing developments are known to devote up to 60 percent of their wages to transportation from home to work and

other areas of economic activities. As a result, poverty is perpetuated and reinforced, which in turn exacerbates post construction maintenance difficulties. The implication for the housing stock and the built environment, from previous developments of this kind, is one of deterioration and dilapidation (Rodriques, 1997).

The physical attributes of these houses can be gleaned from Figures 4.7 – 4.9, which represented different types of low-cost housing developments across South Africa. As can be observed, these are very simple structures that have been constructed from different materials ranging from polystyrene-impregnated concrete slabs to cement blocks and bricks, but the majority are built with cement blocks and plastered over. The size of these houses range from 28 to 42 square meter, which depends on the Provinces, as there are no uniform standards across the country. Owing to lack of funds, majorities of these houses lack insulation, ceilings, and known features of energy efficiency. In these regards, these houses fail to meet the important criteria of socio-cultural sustainability, as these houses have been labelled by default as low status owing to poor design and location.

These aspects of socio-cultural sustainability are perhaps the greatest threats to environmental sustainability in South Africa. The future acceptance of these houses as occupants become economically empowered is seriously in doubt. If this happens, a ghost town scenario develops or a typical inner city syndrome ensues where households abandon their houses in certain parts of the city as they become economically empowered or where households refuse to relocate to such areas due to giant slumps, deterioration

and decay. In the former case, new greenfields would be dedicated to producing houses that meet with the taste and preferences of the newly economically empowered households. In the latter, the refusal to move into designated low-income housing for the derelicted and deteriorated, leaves these houses unoccupied and as such amounts to a huge waste of scarce resources. Thus, it is imperative that a holistically sustainable approach to low-cost housing is adopted now in order that huge future correction expenditure is avoided.

A further critical look at low-cost construction would reveal the use of new materials with hardly any recycled materials in use, which as argued above, would not only have substantially reduced costs and enhance affordability but would also have reduced the amount of new material inputs. This is particularly surprising given the government's commitment to environmental sustainability and this raises important questions as to whether government's commitment is a mere textbook exercise. The question remains to be asked as to why recycled materials are not specified and insisted upon by local authorities in the construction of low-cost housing despite the huge potential there is for reducing housing costs. Several of the theoretical reasons advanced in chapter two, which range from problems of acceptability to those associating with marketing and access to recycled materials may apply here. However, these theoretical propositions need to be empirically validated in order to determine why recycled materials are not specified for reuse in low-cost housing construction in South Africa.

CHAPTER 5:

RESEARCH DESIGN

5.1 Introduction

According to Leedy (1992), research is the manner in which the researcher attempts to solve problems in a systematic effort, to overcome the barriers of human ignorance or to confirm the validity of the solutions to problems others presumably have solved. According to Stacks and Hocking (1992), the essence of any research is its validity which means that the researcher has measured that which he/she has intended to measure and the reliability of the resources that was utilized.

In selecting the method to use in collecting data, the evaluator needs to analyze the accepted scientific methods to see whether or not it will provide the researcher with valid and reliable information. The various research methods such as experiments; case studies; surveys as well as questionnaires and interviews will be addressed within this chapter.

5.2 Experimental Research

Experiments can be carried out in a natural setting (field) or in an artificial one (laboratory). Within the laboratory the researcher creates the exact conditions required, the researcher then controls some factors and manipulates others within this predetermined setting. The independent variable within its natural environment is placed under practicable controlled conditions.

Experimental research aims at conclusions regarding cause- and- effect relationships between variables. Due to the control available during the experiment, the researcher is afforded the opportunity to isolate the observed relationship/s between the independent variable, (i.e. exposure time, temperature, cost and anything which is selected to show its

influence on the dependent variable) and the dependent variable. This is done simultaneously with the neutralizing of the effects of extraneous variables (differences between test units and/or control units, i.e. any factors except the experimental treatment factors that influence the dependent variable). During an experiment the information is obtained by following the rules and guidelines of the applicable scientific method, thus allowing minimum potential for errors to occur (Bell, 1993).

Cohen and Manion (1984) agree that the variation in the result attained from experiments is due to three possible sources. Primary variation which is related to the influence of treatment and independent variables, secondary variations which can be ascribed to extraneous forces and thirdly, the variation in measurement.

5.3 Case Study

Allen and Santrock (1993) defined the case study method as an in-depth analysis of the thoughts, fears, feelings, beliefs or behaviour of an individual within the research subject. Case study research takes place only when investigators analyze a collection of case studies, looking for threads of consistency that permits general conclusions. A variety of data collection techniques can be used in case studies, such as interviewing the subject, direct observation of the subject, examination of records and psychological testing.

According to Wimmer and Dominick (1994), a successful study will provide the researcher with a three-dimensional picture, which illustrates the interaction of factors and events, which are crucial to the determination of the success or failure of an organization. Wimmer and Dominick believe that the use of triangulation, which is a

combination of data collection techniques, is advantageous to the implementation of a case study for the method of triangulation enhances the validity of research findings.

In the event that the researchers' aim is to learn something new from the respondent, the respondent should then be motivated to freely express his/her feelings concerning the subject under research. In other words the data- gathering method should not be totally dependent upon the verbal responses to structured questions (Cohen and Manion, 1984). According to Stacks and Hocking (1992), the use of case studies is more than sufficient when the study is focussed on small groups. Due to their greater demand for individual participation, for greater participation leads to greater involvement in the group and therefore the interviewer can observe whether each participant have a clear understanding of the research topic.

The information that is collected should be systematically classified so that qualitative comparisons can be made. The main disadvantage is that case studies are highly subjective, thus limiting the number of studies when research is subject to resource constraints. It is time consuming and requires training and experience in observing, recording and writing (Fellows and Liu, 1997). Case Studies, whilst being of great benefit in the social sciences is often used effectively in the natural sciences or to validate existing technology, which this work is focussed on.

5.4 The Survey Method

According to Fellows and Liu (1997), surveys operate on the basis of statistical sampling and information concerning the specific aspect of the subject's behaviour, is obtained by means of questionnaires and interviews. The two major survey types used are descriptive and analytical. The descriptive survey is related to that which the researcher sees, observes and that which can be described with words and that which can be concluded from the words. The answers, hopefully, represent the truth of the situation subject to the condition of that time.

The analytical survey method is used to guide a project towards the discovery of new truths and the method of reporting data is by means of numerals, which allows the researcher to examine the interrelationships between variables and to draw explanatory inferences. This approach requires the examination of two or more variables in order to test the research hypotheses (Leedy, 1992).

According to Wimmer and Dominick (1994), the advantages of using the survey methods can be listed as follows:

1. Surveys can be used to investigate problems in realistic settings.
2. The cost incurred is dependent upon the amount of information gathered.
3. A large amount of information can easily be collected from a variety of people.
4. The survey technique allows the researcher to examine a large number of variables that can be analyzed with the help of multivariate statistics. Examples are lifestyle information, attitudes, motives and intentions.

The disadvantages can be listed as follows:

1. The independent variables cannot be manipulated as in the experimental research.
2. Without this control, the researcher cannot be certain whether the relationship that exists between dependent and independent variables are casual or non-casual. Nor can the interdependence of the independent variable on another be determined beyond any doubt.
3. Casualty is difficult to establish because many intervening and extraneous variables are involved.
4. Surveys depend on sampling techniques. The sample may be biased due to some part of the population being over represented or under represented, people may not answer questions truthfully and this will affect the end result of research.

5.5 Interviews And Questionnaires

An interview is a face-to-face dialogue (it can also take place over the telephone) which is conducted to obtain research- relevant information about specific aspects of a subject's behaviour, for the result to be effective advance planning is essential. According to Wimmer and Dominick (1994), in- depth interviews are used to explore and to uncover participants' perspectives on a particular issue. In other words it can provide the researcher with detailed background about the reasons why participants give specific answers. It further allows for observations of participants' non- verbal behaviour; and can provide extensive data concerning participants' opinions; recollections; values; motivations and feelings.

There are four ways of gathering data through direct verbal interaction between individuals: it is by means of structured or unstructured interviews; the non- directive interview; and the focussed interview. The structured interview is when the content and procedures are organized in advance; i.e. the sequence and wording of the questions are predetermined. Unstructured interviews are also carefully planned but it gives the interviewer greater flexibility than a structured interview, for the sequence and wording of questions is entirely in the hands of the interviewer.

The non- directive interview provides the interviewer with minimal control on the course that the interview will engage in, for this method of data gathering encourages the respondent to freely express his feelings about the subject under investigation. A non-directive interview is usually implemented when the interviewer has little knowledge on the research topic.

During a focussed interview the interviewer can play a more active role than during a non- directive interview, this can be ascribed to his personal involvement in a particular situation, which provided him/her with the necessary knowledge to guide the direction of the conversation (Cohen and Manion, 1984).

A questionnaire is the method employed by the researcher, whereby the subjects are administered a series of written questions designed to obtain information about attitudes, opinions, and specific aspects of their behaviour. A questionnaire is similar to a highly

structured interview except that the respondents read the questions and mark their answers on paper rather than responding verbally to the interviewer (Plotnik, 1993).

According to Plotnik (1993), it is crucial that long and complicated questions are avoided especially when surveys are done telephonically. Questions in mail surveys need to be unambiguous, simple and well explained and should be understood by all the respondents, as there may not be an opportunity for further clarification.

Questions vary with regard to content according to the type of information required. The four basic types of questions are factual questions; questions on opinions and attitudes; information questions (these are used to discover what respondents know about certain events); questions on behaviour. There are two basic question formats, namely the open-ended questions (free response or unstructured) and the closed or structured questions (Stacks and Hocking, 1992).

5.5.1 Advantages of open questions

a) open questions impose no restriction on a response

b) they are appropriate where the researcher's knowledge of the subject is limited

c) open questions are also appropriate for pilot work

d) they assist in determining more deeply- rooted motives, expectations and feelings

Disadvantages of open questions

a) open questions are time consuming, thus limiting the number of questions

b) the success of the response depends on the competence of the interviewer

c) open questions can easily be misleading

d) responses are often incomplete

e) open questions are easy to ask, difficult to answer and even more difficult to analyze

5.5.3 Advantages of structured questions

a) structured questions are easy to administer, process and analyze due to prior coding

b) answers are standard and can be compared between groups

c) structured questions are economical and less time consuming

d) the respondent is often clearer about the meaning of his response

e) it is easier to quantify responses, which differ both in terms of topic and in the extend of emotional expression

Disadvantages of structure questions

a) structured questions can often lead to loss of rapport and frustration, because respondents may often be forced to make artificial choices which they would not make in reality

b) structured questions are often less subtle and the respondent can easily discern the intention behind the question

5.6 Quantitative Research Approaches

This research approach is mainly empirical or experimental, and is based on the measurement of quantity or amount, i.e. the study of factual data. Quantitative research concludes the structuring of a research questionnaire or a hypothesis in order to test it against the facts of "reality" (Fellows, 1997).

5.7 Qualitative

Qualitative research is analytic and interpretive. It aims to analyse events in a holistic manner. Unlike the quantitative approach, no attempt is made to control events. Examples of quantitative research in communication include, field observation, focus groups, in-depth interviews, case studies and social surveys, among others (Wimmer & Dominick, 1991). However, Leedy (1993) argues that the difference between these two types of research approaches is that if the data is numerical, the methodology is quantitative; if the data is verbal, the methodology is qualitative. Leedy (1993) continues by explaining that the nature of the data, and the problem of the research dictate the research methodology.

5.8 Triangulation

Triangulation aspires to include the use of more than one source of data collection in a single research project. The aim of triangulation research is to increase the reliability of the results, and to compensate for the limitations of each method (Fellows, 1997).

5.9 Descriptive Research

According to Stacks and Hocking (1992), within a research field one can observe the behaviour and then write down that which has been observed. Similarly, the message can be observed so that one can describe a certain even.

If we are interested in, the way President Mandela's speeches contribute to the democratization of South Africa then a content analysis of those speeches will tell us what topics the President spoke about, the frequency of selected topics, and the persuasive appeals he used. Thus, by drawing inferences, the reason for having addressed those concerns can be identified. Content analysis, as a descriptive method, is a starting point for establishing the effects of a particular set of messages (Stacks and Hocking, 1992).

5.10 Reliability of Research

In the event that the method of data collection was reliable, it means that anybody else using the same method, or the same person using the same method at another time, would come up with the same results. Internal reliability refers to the extent to which the data collected, analysis, and interpretation are consistent, given the same conditions. External reliability deals with the issue of whether or not independent researchers can duplicate studies in the same or similar settings and obtain similar results (McNeil, 1992).

5.11 Research Methodology Chosen, Justification, and Problems Encountered

The methodology adopted for this research reflected the desire to select the most effective method for data collection that specifically addresses the hypothesis that the recycling and reuse of construction materials would significantly enhance affordability and environmental sustainability in South Africa. Due to the nature of data required, the questionnaire method was used to access primary data from all stakeholders in the production, delivery and consumption of low-cost housing in the Western Cape. To facilitate data analysis and in the presence of a variety of software packages available for data manipulation the Statistical Package for the Social Sciences ($SPSS^x$) was selected because of its versatility and the fact that it is extensively used in analysing social science research. Considering the advantages of having frequency analyses and the opportunity to cross tabulate results, SPSSx is flexible and favoured in social science empirical analysis (Earl *et al*, 1995).

The sample size was randomly selected owing to the fact that the full population could not be surveyed because of cost and time factors, which meant that the sample size has to be randomly selected in order to present a true representation of the total population. This was done by first identifying the various stakeholders such as architects, local authority housing departments, low-cost housing sites, and selected households. In each of these categories, lists were produced and each name on the list was folded and put in to a bag after which the desired sample size was drawn blinded for each of the categories. The selected areas for the survey include **Delft extension, Westbank, Belleville, Khayelitsha, Nyanga, Mufeleni and Vrygrond** and each area received the same number

of questionnaires with the validity of the data received being dependant on a particular date selected for the surveys. This procedure ensured bias in data was minimised.

The number of questionnaires disseminated to the homeowners was 140 of which 95 were received, which is 68 percent rate of response. In receipt of the data efforts were made to clean to take account of missing values. In the case of the professional stakeholders 35 questionnaires were distributed of which 32 were returned, recording a 91 percent response rate. The same procedure as above was applied.

5.12 Rationale for the Questions Asked

The questionnaire was subdivides into two sections, one addressed to the homeowner and the other to construction professionals, including architects, local authorities and suppliers of construction materials.

5.12.1 Homeowners Identity Details

Question one addresses the geographical details of the sample selected and coincides with the limitations governing the research. Questions 2, and 3 provide details of population and establish occupancy rates and population distribution, which seek to validate the theoretical discussions on these issues in chapters 2, 3, and 4. Questions 4, and 5 are posed with the intention of validating the dependency rate provided by Silitshena, (1999) and Hjort af Ornas, (1990), which were rather very high in Africa. Questions 6 and 7 are geared to providing information on the socio-economic situation of the sample and seek to establish their economic potentialities, which is useful to policy prescription.

5.12.2 Property Type

Question 8 is aimed at establishing the extent to which recycled materials are used and accepted by households in response to the theoretical discussions in chapters 2 to 4. This is particularly the case given the assertions of Ngowi (1996); UNDP (1999); Kweku.*et al*, (1989) and Cakin (1989), that materials usage depends upon local availability, cultural and status preferences and influences of construction norms.

Questions 9, 10, 11 and 12, whilst establishing design and housing need, are tied directly to the potential impact of housing demand on biophysical resources. This connects with the finiteness of the natural environment as presented in chapter four and indicates the need for alternative sources of material input to construction (Department of Housing, 1995, Häkkinen and Sarah, 1998). Question 13 and 14 are posed in order to establish the rate of resource depletion and the pollution generated in general and those relating to housing construction and consumption specifically.

5.12.3 Housing Affordability

Question 15 and 16 will establish the nature of affordability related issues while questions 17,18 and 19 looks at property types and hope to capture occupants' expectation and opinions about the houses they are provided (Häkkinen and Saari, 1998). In particular, the questions on housing affordability are aimed at establishing the relationship between the desired needs of the homeowner in terms of materials requirements and preferences and their ability to fulfil these needs. This is an important aspect in the debate for promoting the use of sustainable materials.

5.12.4 Environmental Issues

Questions 20-38 address issues relating to environmental sustainability by first seeking to gauge the environmental awareness of households with a view to establishing their openness to new ideas, especially on the acceptance of recycled construction wastes as suitable construction materials. This is essential in view of the discussions in the theoretical chapter.

5.12.5 Professional Stakeholder Identity Details

Questions 1-3 address the geographical details of the sample selected and coincide with the limitations governing the research. Local authority, professional status of respondents, the nature of their organisations and their rankings are established. Questions 4-29 were used to source information on the potential of recycling to facilitate housing affordability and demand (Dept. of Housing, 1995, IWMB, 1995), material specification and design preference (Ngowi, 1996) and the question of biophysical and social sustainability (Du Bose *et al.*, 1997, CSIR, 1999, Agenda 21).

5.13 Conclusion

This chapter dealt with the various methods of data collection. The theory pertaining to research methods has been clearly defined and discussed. Reference was also made to the fundamental characteristics of the research process, which is that the research method decided upon is determined by the type of data required to test the hypothesis so as to attain valid and reliable results.

The research method chosen for the research is discussed and justified. Similarly the process by which data sample was randomly selected and data acquired was also discussed. The next chapter presents the data analysis to the research.

6.1 Introduction

As indicated in chapter 5, chapter six presents the empirical validation of the theoretical analysis underpinning the research. The specific survey results generated were the frequency analysis, a cross tabulation exercise was further engaged in order to provide validity and data which would add significance to the literature review previously completed.

6.2 Key to the Analysis

The following key titles are clarified by means of explanatory definitions.

- Value labels = the variables being analysed;
- Value = coded values attached to each variable;
- Frequency = the number of times a variable occurs in the sampling;
- Percentage = refers to frequency of a variable as a percentage of total sample size;
- Valid percent = takes account of missing observations from the total sample size.

In the analysis besides the above indicators frequencies and percentages have been used.

6.3 Survey Results: Homeowners

Table 6.1 indicates the sampled areas for the study and also shows the response rates. As can be observed, apart from Bellville with 20 percent response rate, Khayelitsha with 18 percent response rate, and Mpuleni with 9 percent response rate, responses from other areas were approximately the same.

Table 6.1 Area Of Residence

Valid	Frequency	Percent	Valid Percent	Cumulative %
Delft	12	12.6	12.6	12.6
Westbank	11	11.6	11.6	24.2
Bellville	20	21.1	21.1	45.3
Khayelitsha	18	18.9	18.9	64.2
Nyanga	15	15.8	15.8	80.0
Mfuleni	9	9.5	9.5	89.5
Vrygond	10	10.5	10.5	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Figure 6.1 Area of Residence

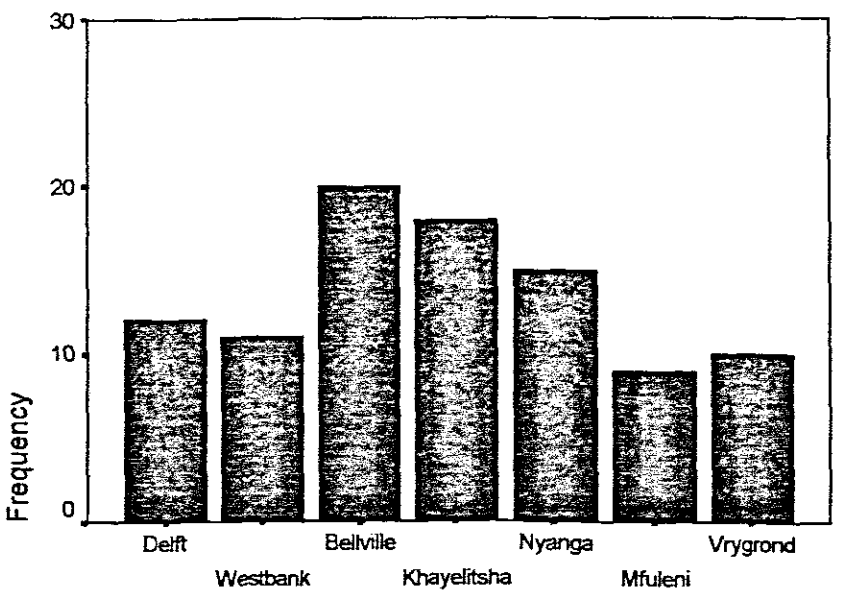


Table 6.2 Sex

Valid	Frequency	Percent	Valid Percent	Cumulative %
Male	45	47.4	47.4	47.4
Female	50	52.6	52.6	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases =0				

Table 6.3 Number of Residents

Valid	Frequency	Percent	Valid Percent	Cumulative %
0-2	31	32.6	32.6	32.6
3-5	41	43.2	43.2	75.8
6-over	23	24.2	24.2	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Within these areas and to further add meaning to the sample selected the ratio of males (47.4%) to females' (52.6) is given in Table 6.2 and the number of residents is shown in table 6.3. It is significant to note that the sample validates the population structure discussed in chapter three, which indicates a higher ratio of females to males. In Table 6.3 it is evident that 43,2 % of the housing units are occupied by between 3-5 persons, and according to the size of the houses displayed in Table 6.11, 42.1% of the sample falls within the range of 26-30m².

About 24.2% of the residents stay in houses with 6 and over number of persons as occupants. These figures indicate a degree of overcrowding and highlight the shortcomings in shelter provision. These shortcomings are indicative of future demands on materials in the event that homeowners should decide to enlarge their houses to

alleviate such overcrowding. This would be another area of need that could be provided for through the process of recycling.

Table 6.4 Number of Adults

Valid	Frequency	Percent	Valid Percent	Cumulative %
0-2	77	81.1	81.1	81.1
3-5	17	17.9	17.9	98.9
6-over	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.5 Number of Children

Valid	Frequency	Percent	Valid Percent	Cumulative %
0-2	78	82.1	82.1	82.1
3-5	14	14.7	14.7	96.8
6-over	3	3.2	3.2	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.4 and 6.5 are significant in that they present the number of adults and children within households in our survey. On the whole most of these homeowners have 2 adults (81.1%) and 2 children as dependants (82.1%). There is a fairly similar spread between those households, which have 3-5 adults (17.9%) and those households, which have 3- 5 children (14.7%). These figures establish potential earning capacity and dependency rating and once more add detail to the occupancy level when compared with the number of rooms and the shortcomings selected by homeowners as shown in Table 6.9 and Table 6.14. It is apparent from this data that the desire for home improvement is indeed prevalent and in the event of people being able to fulfil this desire do have some

environmental implications as discussed in chapter 4. However, the extent of this demand and its impact on the physical environment depends essentially on the strategy adopted.

Table 6.6 Number Employed

Valid	Frequency	Percent	Valid Percent	Cumulative %
0	1	1.1	1.1	1.1
1	9	9.5	9.5	10.5
2	49	51.6	51.6	62.1
3	31	32.6	32.6	94.7
4-over	5	5.3	5.3	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.7 Type of Employment

Valid	Frequency	Percent	Valid Percent	Cumulative %
Formal	54	56.8	56.8	56.8
Informal	28	29.5	29.5	86.3
Both	3	3.2	3.2	89.5
N/A	10	10.5	10.5	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

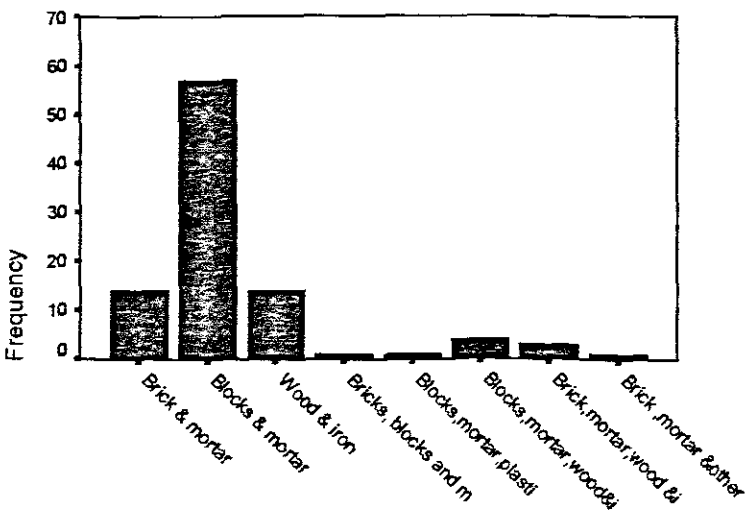
Tables 6.6 and 6.7 are the last tables, which provide identity detail concerning the occupants of the areas used within the sample. In Table 6.6 the number of people in employment show that a fairly high percentage of the occupants are gainfully employed in either formal (56.8%) or informal employment (29.5%) with 3.2% being employed in both formal and informal positions. A 10.5% unemployment rate exists in the sample targeted. In terms of the number of employed 51.6% of the householders have one person employed, 32.6% recorded 2 people and 5.3% recorded 3 people being employed.

Employment is just one of the myriad of factors influencing affordability, but given that 81% of residents are in favour of using alternative building materials, as indicated in Table 6.29, it bodes well for the potential use of recycled materials. As the survey reveals 89.5% employment rate, the problem of affordability is real.

Table 6.8 Housing Material Used

Valid	Frequency	Percent	Valid Percent	Cumulative %
Brick & mortar	14	14.7	14.7	14.7
Blocks & mortar	57	60.0	60.0	74.7
Wood & iron	14	14.7	14.7	89.5
Bricks, blocks and mortar	1	1.1	1.1	90.5
Blocks, mortar, plastic wood and other	1	1.1	1.1	91.6
Blocks, mortar, wood & iron	4	4.2	4.2	95.8
Brick, mortar, wood & iron	3	3.2	3.2	98.9
Brick, mortar & other	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Figure 6.2 Housing Material Used



Tables 6.8, 6.9, 6.10 and 6.11 target directly the design features of the housing types encountered in the sample areas. In terms of the housing materials used as shown in table 6.8 a fairly good material type is displayed with 74.7% of the units being built with bricks and mortar (14.7%) or blocks and mortar (60%). The 14.7%, which is recorded for wood and iron structure displays the statistics received for Vrygrond where informal housing structures dominate. The type of housing, which is most prevalent also indicates the design and specification preference favoured by the Local Authorities, building contractors and professional bodies and also display the reluctance by these bodies to use alternative building material. The significance of which is apparent in the section on the environment, where there was a marked ignorance about the availability of recycled materials.

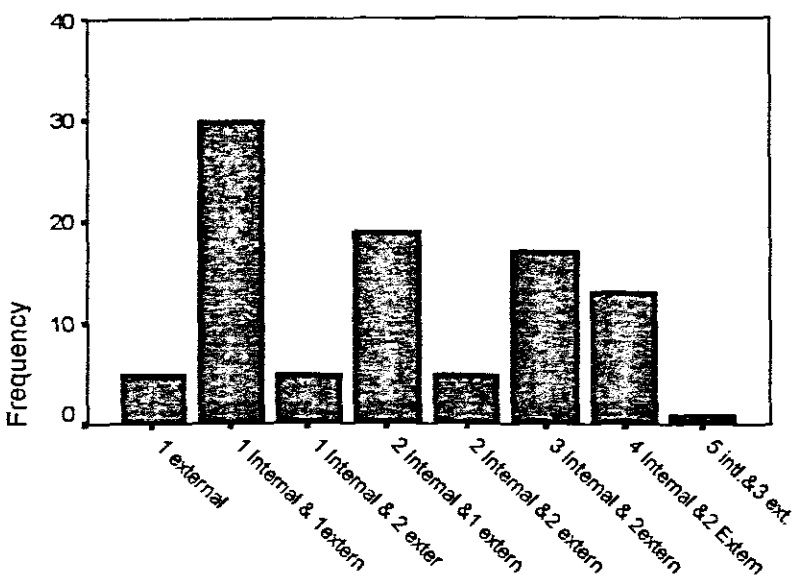
Table 6.9 Number of Rooms

Valid	Frequency	Percent	Valid Percent	Cumulative %
1	7	7.4	7.4	7.4
2	14	14.7	14.7	22.1
3	45	47.4	47.4	69.5
4	14	14.7	14.7	84.2
5	6	6.3	6.3	90.5
6-over	9	9.5	9.5	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.10 Number of doors

Valid	Frequency	Percent	Valid Percent	Cumulative %
1 external	5	5.3	5.3	5.3
1 internal & 1 external	30	31.6	31.6	36.8
1 Internal & 2 external	5	5.3	5.3	42.1
2 Internal & 1 external	19	20.0	20.0	62.1
2 Internal & 2 external	5	5.3	5.3	67.4
3 Internal & 2 external	17	17.9	17.9	85.3
4 Internal & 2 external	13	13.7	13.7	98.9
5 Internal & 3 external	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Figure 6.3 Number of doors



A very significant factor displayed in table 6.10 is the fact that 56.9% of the sample have only one external door, this displays an alarmingly low specification level and has implications for health and safety and indicate a high dissatisfaction level. The significance of this is revealed in the widely acknowledged impact of ventilation on indoor air pollution.

Table 6.11 Number of Windows

Valid	Frequency	Percent	Valid Percent	Cumulative %
1	4	4.2	4.2	4.2
2	5	5.3	5.3	9.5
3	15	15.8	15.8	25.3
4	45	47.4	47.4	72.6
5	8	8.4	8.4	81.1
6-over	18	18.9	18.9	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.12 Electricity Connection

Valid	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Yes	90	94.7	94.7	94.7
No	5	5.3	5.3	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.13 Running Water Connection

Valid	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Yes	81	85.3	85.3	85.3
No	14	14.8	14.8	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Tables 6.11, 6.12 and 6.13 reflect the housing status of the selected sample. The fact that 47.4% have 4 windows indicate that the house size is very limited and relates to Table 6.14 where 91.6% of the house size is below 35m². Table 6.12 identifies the degree to which satisfaction is linked to infrastructure. It is noteworthy that 94.7% of homes are electrified, which can be a stimulant for further home improvement. However only 71.6% are satisfied with their area of residence, which means a 23.1% of the occupants do not link electricity with satisfaction in the area as asked in Table 6.12. The response to the presence of running water also indicates a high percentage (85.3%) of occupants with running water.

As discussed in the literature review, the environmental requirement presented by the client should deal with the quality and quantity of energy used for heating and ventilation, the physical and economic lives and flexibility of the building should be considered. This would be reflected by the environmental quality of building designs and products employed in the construction.

Approximately 8 million South Africans are currently living in informal dwellings, of which most utilise fuels such as wood, coal and paraffin to cook and heat these houses. These fuels have a low energy content and cause health and related problems. As a means to improve on current living conditions in low-income communities and to preserve the environment for future generations, the implementation of energy efficient housing designs, material selection and construction provides a possible solution for this need (Mathews, E.H *et al.*, 1995).

Recycling of materials as a means of suitable material supply could offer an economic source to redress energy depletion and meet Agenda 21 recommendations.

Table 6.14 House Sizes

Valid	Frequency	Percent	Valid Percent	Cumulative %
14-19	6	6.3	6.3	6.3
20-25	26	27.4	27.4	33.7
26-30	40	42.1	42.1	75.8
31-35	15	15.8	15.8	91.6
36-44	3	3.2	3.2	94.7
45-49	4	4.2	4.2	98.9
60-over	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.14, which presents the house size in an area, indicates that the majority of the houses are considerably small. 91.6% of these houses are 35 and below m^2 in area. Given the fact that some houses have up to 6 occupants, these figures indicate a high degree of overcrowding, which interprets into huge potential demand for house building materials, either to enlarge existing inadequate houses or build new ones to meet shortages. This is particularly the case when the new housing standard of 44m^2 stipulated by government as minimum-housing size is implemented. This single policy would render existing low-cost houses mostly inadequate.

Table 6.15 Do You Own Your House

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	88	92.6	92.6	92.6
No	7	7.4	7.4	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.16 Type Of Housing Finance

Valid	Frequency	Percent	Valid Percent	Cumulative %
Loan	14	14.7	14.7	14.7
Subsidy	44	46.3	46.3	61.1
Rent	6	6.3	6.3	67.4
N/A	7	7.4	7.4	74.7
Personal income	24	25.3	25.3	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Tables 6.15 and 6.16, which concern homeownership and housing finance employed in house acquisition indicate that 92.6% are homeowners with only 7.4% renting the units. It is important to note that 46.3% of homeowners received housing subsidy. 25.3% of the homeowners were able to secure their homes (informal) through the use of their own personal income and 14.7 % were considered sufficiently credit worthy by financial institutions to obtain mortgage finance

Table 6.17 Additional Rooms Required

Valid	Frequency	Percent	Valid Percent	Cumulative %
No	26	27.4	27.4	27.4
Yes, 1-2	52	54.7	54.7	82.1
Yes, 3-4	13	13.7	13.7	95.8
Yes, 4-5	3	3.2	3.2	98.9
Yes, 6-over	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

The group of tables 6.17 and 6.18 are homeowners preference indicators in that their additional space needs and their degree of satisfaction of material usage are handled in the table group above in their respective order. In terms of additional space whilst 27.4%

do not require additional space 72.6% need more rooms. These requirements range from 2 rooms (54.7%), to more than 6 rooms (1.1%), which is required to upgrade existing dwellings to a state which the occupants would find satisfactory for their daily existence. This information adds to the housing needs displayed in chapter 3, where the shortfalls in shelter requirements are presented.

The ultimate importance of these statistics, in terms of the recycling focus is that given the type of housing design preferred, up to 72.6% of homeowners will be in the market for additional resources. Unless these additional materials are met from recycled materials, the environmental implications and consequences are considerable, especially where such materials are new because of embodied energy in their production as well as chemicals used in material processing.. This information above is further backed-up in Tables 6.18 where 60% of the respondents stated dissatisfaction with the housing materials used. The implication therefore is that if given the opportunity 60% would change their situation in terms of additional space.

Table 6.18 Satisfied With Housing Materials Used

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	38	40.0	40.0	40.0
No	57	60.0	60.0	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.19 Satisfied With Residential Area

Valid	Frequency	Percent	Valid Percent	Cumulative %
Strongly agree	55	57.9	57.9	57.9
Agree	13	13.7	13.7	71.6
Have reservations	2	2.1	2.1	73.7
Not satisfied	25	26.3	26.3	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Question 20 was geared to establishing the status of satisfaction levels with the physical built environment. It was necessary to obtain this information, as it would indicate the amount and extent of potential changes which people would want to implement to improve their physical environment. The indication is that 57.9% strongly agree that they are satisfied with their built environment, with a further 13.7% agreeing with them. However an uncomfortable 26.3% of households indicated that they are not satisfied with their area, which has implications for environmental resource consumption and demand. However, this demand could be ameliorated by increased use of recycled materials.

Tables 6.20, 6.21,6.22, addressed the environmental question, which is an important aspect in the debate for recycling. In most instances the infrastructure as far as roads are concerned are acknowledged by residents to be well developed. Indications from the bar chart are that for the most part amenities are considered to be lacking.

However taking Tables 6.22 and 6.23 in tandem, 65.3% of respondents acknowledged that the physical environment has important bearing on quality of life. This is substantiated by the 85.3% that rated environmental issues as important, 43.2% agreeing that it is very important and 42.1% who considered it as being fairly important. Provided

that a link can be established between environmental degradation and insatiable demand for environmental resources. The strong expression shown for the environment by respondents provides a basis for encouraging recycling.

Table 6.20 Areas Suitably Developed

Valid	Frequency	Percent	Valid Percent	Cumulative %
Roads, stormwater	16	16.8	16.8	16.8
Roads, shops, schools, parks, playgrounds	1	1.1	1.1	17.9
Roads, stormwater, shops, schools & streetlights	10	10.5	10.5	28.4
Roads, stormwater, parks, playgrounds	3	3.2	3.2	31.6
Roads, stormwater, shops & schools	2	2.1	2.1	33.7
Shops	2	2.1	2.1	35.8
All yes	7	7.4	7.4	43.2
Roads, stormwater & streetlights	21	22.1	22.1	65.3
All no	6	6.3	6.3	71.6
Roads, stormwater, shops & street lighting	9	9.5	9.5	81.1
Roads & street lighting	3	3.2	3.2	84.2
Stormwater drainage &street lighting	2	2.1	2.1	86.3
Roads, shops, schools & street lighting	1	1.1	1.1	87.4
Roads, schools & street lighting	2	2.1	2.1	89.5
Roads, shops & street lighting	2	2.1	2.1	91.6
Roads, shops, schools & street lighting	1	1.1	1.1	92.6
Street lighting	3	3.2	3.2	95.8
Shops &street lighting	2	2.1	2.1	97.9
Schools	1	1.1	1.1	98.9
Roads	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Figure 6.4 Areas Suitably Developed

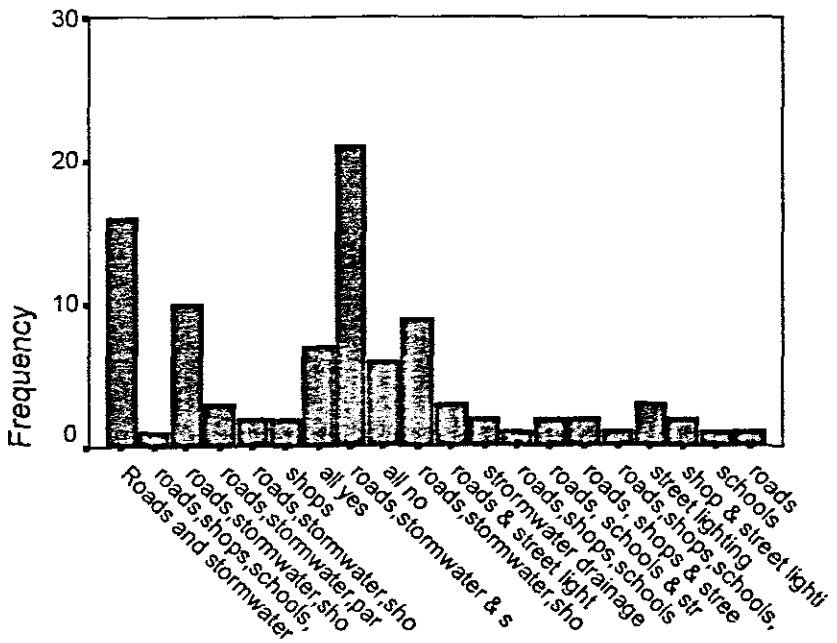


Table 6.21 State Of Infrastructure

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Bad	43	45.3	45.3	45.3
Satisfactory	41	43.2	43.2	88.4
Good	11	11.6	11.6	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.22 Importance Of Surrounding Area To Quality Of Your Life

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	62	65.3	65.3	65.3
No	33	34.7	34.7	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.24, which sought to discover if the environmental concerns are practised within households show a degree of similarities with Table 6.23, which discussed the importance of the environment. In Table 6.24 a majority of 66.3% respondents indicate that environmental concerns are reflected in their home activities. This indicates a degree of environmental awareness amongst respondents.

Table 6.23 Rate Importance Of Environmental Issues

Valid	Frequency	Percent	Valid Percent	Cumulative %
Not important	13	13.7	13.7	13.7
Fairly important	40	42.1	42.1	55.8
Very important	41	43.2	43.2	98.9
21.00	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.24 Environment Being Part of All Your Activities At Home

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	63	66.3	66.3	66.3
No	32	33.7	33.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.25 Shortage Of The Following Materials

Valid	Frequency	Percent	Valid Percent	Cumulative %
Don't know	6	6.3	6.3	6.3
All yes	23	24.2	24.2	30.5
Blocks and sand	2	2.1	2.1	32.6
Bricks, blocks, cement, sand & timber	2	2.1	2.1	34.7
Bricks, cement, sand & timber & iron/metal	4	4.2	4.2	38.9
Cement & timber	2	2.1	2.1	41.1
Bricks, blocks, cement, sand	3	3.2	3.2	44.2
Bricks, cement, timber & iron metal	6	6.3	6.3	50.5
Blocks, cement, sand	2	2.1	2.1	52.6
Blocks, cement, & iron metal	2	2.1	2.1	54.7
Bricks, cement & iron metal	1	1.1	1.1	55.8
Bricks & cement	2	2.1	2.1	57.9
cement & timber	1	1.1	1.1	58.9
All no	16	16.8	16.8	75.8
Bricks, blocks, cement, timber & iron metal	5	5.3	5.3	81.1
Blocks, cement, sand timber & iron metal	2	2.1	2.1	83.2
Bricks	1	1.1	1.1	84.2
Cement	3	4.2	4.2	87.4
Bricks & sand	2	3.2	3.2	89.5
Bricks, blocks, cement, sand & iron metal	1	2.1	2.1	90.5
Timber & iron metal	4	1.1	1.1	94.7
Bricks, cement, sand & timber	2	2.1	2.1	96.8
Timber	1	1.1	1.1	97.9
Bricks, timber & iron metal	2	2.1	2.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Figure 6.5 Shortage Of The Following Materials

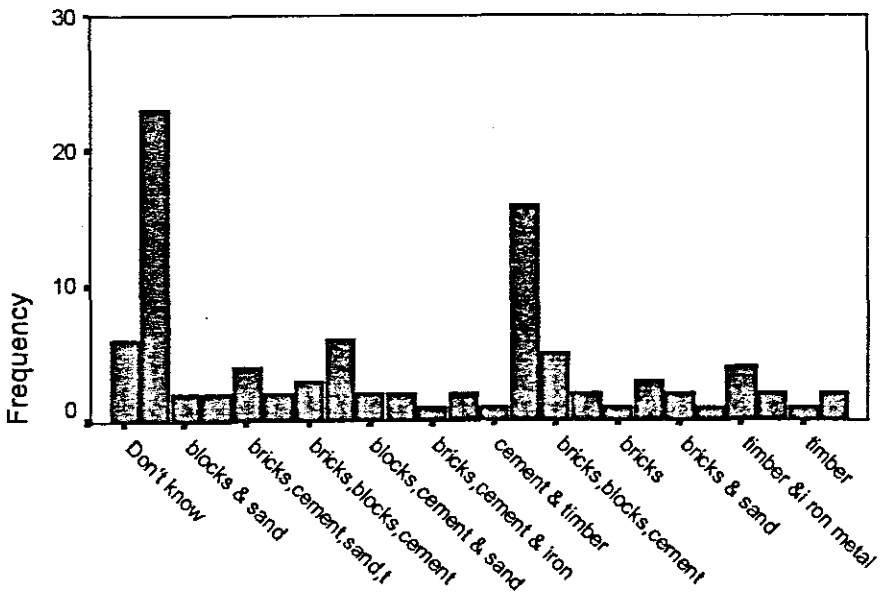


Table 6.26 Can The Rate Of Production Of Building Materials Be Sustained?

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	45	47.4	47.4	47.4
No	48	50.5	50.5	97.9
Maybe	2	2.1	2.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.27 Production Of Building Material Harmful To The Environment

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	52	54.7	54.7	54.7
No	39	41.1	41.1	95.8
Maybe	4	4.2	4.2	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.28 Would You Consider Different Methods Of House Building?

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	70	73.7	73.7	73.7
No	24	25.3	25.3	98.9
Maybe	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.29 Would You Consider Alternative Materials In House Building?

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	77	81.1	81.1	81.1
No	15	15.8	15.8	96.8
Maybe	2	2.1	2.1	98.9
11.00	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

In the sample selected Tables 6.25, 6.26, 6.27, 6.28 and 6.29 are specifically directed to establishing the environmental perceptions of homeowners. These tables focus on shortage of materials shown in Table 6.25, the rate of production and maintenance of building (table 6.26), the impact of the production of building materials on the environment (Table 6.27), the attitude of the respondent to employing different methods of house building (Table 6.28) and the inclination for alternative material use in house building.

The perceptions, of respondents indicate that 83.2% agree that there is a real shortage of construction materials, with only 16.8% indicating no shortage whatsoever. Table 6.27, which deals with the impact of the production of building materials on the environment,

and 54.7% of respondents perceive the production of building materials as harmful to the physical and biotic environment. However a considerable number of households (45.3%) show a scant concern for the environment.

Table 6.28 and 6.29 indicate that 72.6% of the sample would consider different methods of house building and a significant 81.1% would use alternative materials in house building. These statistics bode exceedingly well for recycling, given the fact that majority of respondents require more space and in some cases, new housing. Thus, the overwhelming willingness to consider different methods of housing and alternative materials makes the job of selling recycling relatively easier.

Table 6.30 Use Of Second- Hand Building Material

Valid	**Frequency**	**Percent**	**Valid Percent**	**Cumulative %**
Yes	37	38.9	38.9	38.9
No	57	60.0	60.0	98.9
Maybe	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.31 Experience With The Use Of Recycled And/Or Used Building Material

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	24	25.3	25.3	25.3
No	71	74.7	74.7	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.32 Material / Components Used In Housing Construction

Valid	Frequency	Percent	Valid Percent	Cumulative %
Used all	2	2.1	2.1	2.1
Bricks	1	1.1	1.1	3.2
Windows & doors	1	1.1	1.1	4.2
Timber	2	2.1	2.1	6.3
Iron/metal products	1	1.1	1.1	7.4
Other bldg material, i.e., zinc/containers	1	1.1	1.1	8.4
N/A	70	73.7	73.7	82.1
All except bricks & iron metal products	1	1.1	1.1	83.2
Blocks, concrete, windows and doors	1	1.1	1.1	84.2
Blocks, windows, doors & timber	6	6.3	6.3	90.5
Bricks, blocks, doors concrete, windows &	2	2.1	2.1	92.6
Windows, doors & iron/metal products	2	2.1	2.1	94.7
All except timber	1	1.1	1.1	95.8
All except concrete & timber	2	2.1	2.1	97.9
Timber & iron/metal	2	2.1	2.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Figure 6.6 Material / Components Used In Housing Construction

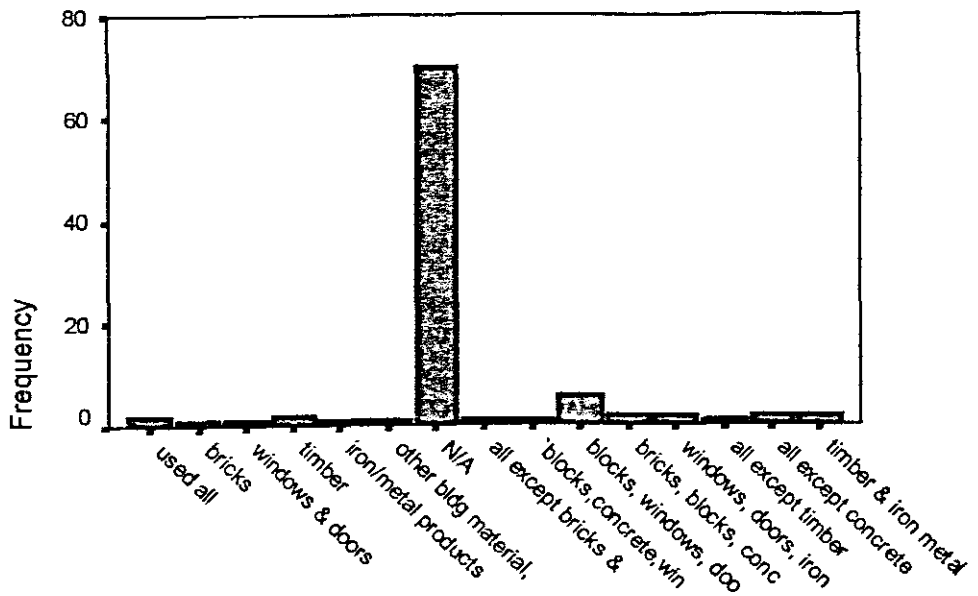


Table 6.33 Recycled And/Or Used Construction Material Depot

Valid	Frequency	Percent	Valid Percent	Cumulative %
2nd Hand Shop	10	10.5	10.5	10.5
Stolen	1	1.1	1.1	11.6
Scrap yard	1	1.1	1.1	12.6
Demolition building sites	6	6.3	6.3	18.9
Another person	7	7.4	7.4	91.6
N/A	70	73.7	73.7	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

The table group, Tables 6.30, 6.31,32 and 6.33 progressively targets the perception of the interviewees in relation to the actual use of recycled materials. Table 6.30 thus considers the use of second-hand building material, whilst Table 6.31 looks at the experience with the use of recycled and or used building materials. Table 6.32 is specifically aimed at establishing the material and component types the respondents have had experience with, and Table 6.33 endeavours to discover the source of recycled and or used material.

The perception on second-hand material is negative as the idea is rejected by 60% of respondents with only 40% willing to consider second-hand materials in building. In terms of Table 6.31 the indication is that very little experience (74.7%) has been had with the use of recycled or second-hand building materials. This response corroborate the findings in Table 6.32, where 73.7% responded negatively to the use of second-hand materials. Those who have not had experience with recycled materials put it down to lack of prior knowledge about source of supply. This is validated by the findings in Table 6.33 where 72.6% of respondents are aware of recycled material suppliers.

The responses indicate that most materials were obtained from second-hand shops, demolition sites or from other members of the community. The evidence shows that with more second-hand shops, households are more likely to use recycled materials, especially where the economics are right as shown in Table 6.35.

Table 6.34 Availability Of Recycled Material

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	42	44.2	44.2	44.2
No	52	54.7	54.7	98.9
Sometimes	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.35 Recycled Material Reasonably Cheaper Than New Material

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	85	89.5	89.5	89.5
No	9	9.5	9.5	98.9
Sometimes	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.36 The Process Of Recycling Help In Saving The Natural Resources

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	82	86.3	86.3	86.3
No	12	12.6	12.6	98.9
Sometimes	1	1.1	1.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

Table 6.37 Recycling Will Contribute Towards Reducing The Cost Of Construction

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	80	84.2	84.2	84.2
No	13	13.7	13.7	97.9
Maybe	2	2.1	2.1	100.0
Total	95	100.0	100.0	
Total	95	100.0		
Valid Cases = 95; Missing Cases = 0				

The final group of tables, Tables 6.34, 6.35, 6.36 and 6.37 are aimed at identifying the perception and attitude regarding the advantages in terms of cost, availability, the ability to save and sustain natural resources and the impact on construction cost. In terms of the cost of recycled materials, they are considered to be cheaper than new materials (89.5%). However as regards availability most respondents (54.7%) feel that recycled materials are not readily available. In terms of the potential of recycling to assist in the saving of natural resources and in its ability to reduce the cost of construction there is a definite perception that recycling will contribute positively with about 86.3% and 84.2% in agreement, as shown in Tables 6.36 and 6.37 respectively.

It would seem that generally the attitude towards recycling and material use in construction appears to be positive from the point of view of potential users, it now remains to identify the perception of the other construction stakeholders. This is necessary for the purpose of policy prescription to facilitate the recycling of construction waste.

6.4 Survey Results:- Professional Stakeholders

This category of stakeholders includes the local authority, professional designers and suppliers. Firstly, the stakeholders within their professional categories had to be identified and the results indicate that 28.1% are local authority employees, 28.1% professional designers and the other 43.8% were building material suppliers (Table 6.38). It was felt that as suppliers would be a very important cog in the promotion of recycled materials their opinion on a broader scale would add greater validation to the data

analysis.

Table 6.38 Category Of Employment

Valid	Frequency	Percent	Valid Percent	Cumulative %
Local Authority	9	28.1	28.1	28.1
Professional Designer	9	28.1	28.1	56.3
Supplier	14	43.8	43.8	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Table 6.39 adds further clarifications to the data obtained in Table 6.38 by indicating the municipalities surveyed and response rates to the questionnaire conducted. Accordingly, Table 6.39 shows a 53.1% response from the Tygerberg Municipality a further 31.3% were received from Cape Town Municipality and the remainder from the Oostenberg Municipality. This spread is similar to the spread received from the homeowners, and indicates sufficient spread for validation in the Western Cape.

Table 6.39 Under Which Municipal Area Do You Fall?

Valid	Frequency	Percent	Valid Percent	Cumulative %
Cape Town Municipality	10	31.3	31.3	31.3
Tygerberg Municipality	17	53.1	53.1	84.4
Oostenberg Municipality	2	6.3	6.3	90.6
Athlone	1	3.1	3.1	93.8
Kensington	1	3.1	3.1	96.9
Worcester	1	3.1	3.1	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Table 6.40 What Position Do You Hold In Your Organisation?

Valid	Frequency	Percent	Valid Percent	Cumulative %
Assistant Project Manager	3	9.4	9.4	9.4
Project Manager	5	15.6	15.6	25.0
Deputy Treasurer	1	3.1	3.1	28.1
Project & Community facilitator	1	3.1	3.1	31.3
Road Works Manager	1	3.1	3.1	34.4
Chief Clerk	1	3.1	3.1	37.5
Environmental Officer	1	3.1	3.1	40.6
Waterworks Manager	1	3.1	3.1	43.8
Associate Partner	1	3.1	3.1	46.9
Engineer	1	3.1	3.1	50.0
Site Manager	4	12.5	12.5	62.5
Architect	3	9.4	9.4	71.9
Director	3	9.4	9.4	81.3
Sales Manager	5	15.6	15.6	96.9
QS	1	3.1	3.1	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Table 6.40 is the last one, which personalises the target sample and is indicative of the position and authority of the respondent within their organisation. It will be noticed that most of the respondents fall within managerial positions or financial control situations. This implies that the respondents are largely involved in policy-making and as such exert considerable influence on the construction industry. It will be noted that the spread of positions are fairly wide but generally 6.2% are involved primarily with finance, 15.6% are directly involved with design, 15.6% are directly involved with supplies, the remainder are involved with managerial operations. This sample therefore is suitably representative of the stakeholders in control of the industry.

Table 6.41 Does Your Organisation Have An Environmental Policy?

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	22	68.8	68.8	68.8
No	9	28.1	28.1	96.9
Maybe	1	3.1	3.1	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Table 6.42 Is Your Policy Attached To A21 And/Or LA21

Valid	Frequency	Percent	Valid Percent	Cumulative %
Agenda21	12	37.5	37.5	37.5
Local Agenda21	11	34.4	34.4	71.9
Both	1	3.1	3.1	75.0
N/A	8	25.0	25.0	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Tables 6.41 and 6.42 are posed with the expressed intention of ascertaining the attitude of professional bodies towards the state of the environment. Thus in Table 6.41 we find that of the responses received in terms of policy formulation regarding the environment, 68.8% confirm that their organisation has an environmental policy, whilst 31.2% responded negatively or were uncertain. Table 6.42 presents similar figures in terms of responses where 75% of respondents devised their policies along the terms of the Rio's Agenda 21, and 25% having no regard for Agenda 21 in their policies.

Table 6.43 Consultation With Stakeholders During Policy Formulation

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	22	68.8	68.8	68.8
No	6	18.8	18.8	87.5
Uncertain	1	3.1	3.1	90.6
N/A	3	9.4	9.4	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Table 6.44 Was The Information Incorporated Into Your Policy?

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	19	59.4	59.4	59.4
No	4	12.5	12.5	71.9
Uncertain	2	6.3	6.3	78.1
N/A	7	21.9	21.9	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Tables 6.43 and 6.44 target the attitude of professional stakeholders towards their clients when formulating policy. In Table 6.43, 68.8% of the respondents had consultations regarding policy formulation. Furthermore, Table 6.44 shows that 59.4% of the respondents indicated that policy was informed by such consultation outcomes.

Table 6.45 Strategies For Sustainable Development Is Considered At Planning Stage

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	24	75.0	75.0	75.0
No	4	12.5	12.5	87.5
N/A	4	12.5	12.5	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

In terms of the literature review on the environment this information established the degree to which sustainable development features as input in physical design formulation. This is evidenced by the 75% of respondents, which agreed that strategies for sustainable development do influence the design process. However, there appears to be similar response from those who disagree (12.5%) and those who claimed that the question did not apply to them (12.5%), which when added together constitute a total of 25% who disagreed or found the question inapplicable. Thus some work needs doing to convince this 25% of the need to implement Agenda21.

Tables 6.46, 6.47 and 6.48 will by means of the data received, establish the importance of materials and also the extent to which circumstances of material availability dictates design. This information ties in with the trends presented in chapter 4 of the literature review, which indicated international as well as the local trends regarding the depletion of environmental resources. Further in terms of local material depletion Tables 6.47 is directly linked to the recycling chapter in terms of establishing the extent to which local material availability will potentially influence the decision to use recycled materials. Lastly Table 6.48 in very specific terms targets the respondents understanding and perception of the environment.

In Table 6.46 only 25% of respondents were able to ascertain the effects of materials on design (25%). The other 75% were either uncertain or did not know. In terms of the use of local materials, Table 6.47 shows that 50% of the responses agreed that availability of materials is taken into account at the design stage, which impacts on material

specification. However, only 6.3% responded with a definite no, another 6.3% indicated that the question was not applicable to them. These statistics are an indication of the demand, which is placed on local material in construction. The response in Table 6.48 is fairly unforeseen in that whilst 68.8% indicated in Table 6.41 that their organisation had an environmental policy only 50% of the respondents perceived material resources availability as being unlimited. This indicates that the understanding and acceptance of the limited character of the environment is only understood to an average degree.

Table 6.46 Impact Of Availability Of Materials On The Design Process

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	8	25.0	25.0	25.0
Sometimes	14	43.8	43.8	68.8
No	2	6.3	6.3	75.0
N/A	8	25.0	25.0	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Table 6.47 Impact Of Local Availability Of Materials On The Design Process.

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	16	50.0	50.0	50.0
Sometimes	12	73.5	73.5	87.5
No	2	6.3	6.3	93.8
N/A	2	6.3	6.3	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Table 6.48 Is Material Supply Availability Unlimited?

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	16	50.0	50.0	50.0
No	16	50.0	50.0	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Table 6.49 Perception Of Low-Cost Housing Design.

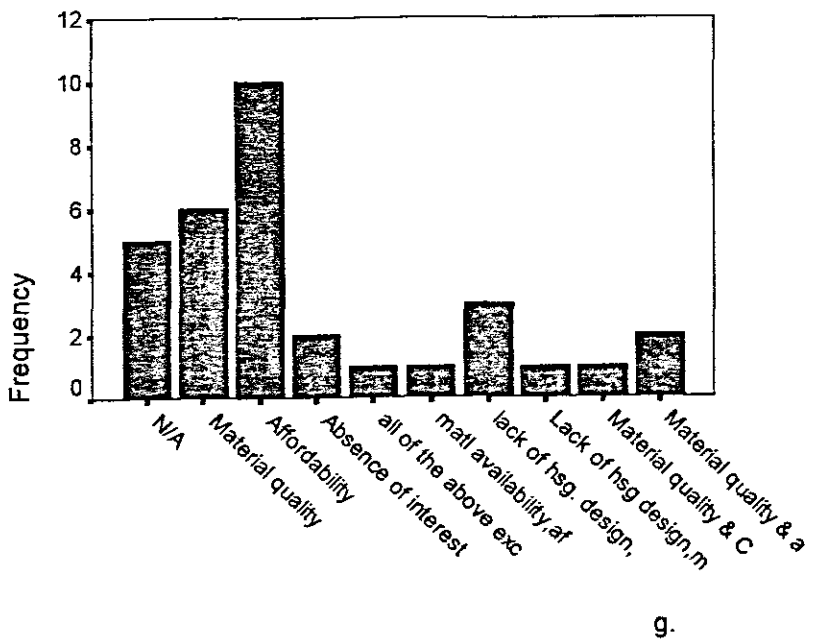
Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	10	31.3	31.3	31.3
Sometimes	2	6.3	6.3	93.8
No	20	62.5	62.5	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Table 6.49 indicates that only 31.3% of the respondents feel that low cost housing design is adequate. This is not surprising given the state of low-cost housing as detailed in the literature review and supported by the findings in Table 6.16 regarding the built environment of the respondents.

Table 6.50 Important Factors In Not Providing Adequate Housing

Valid	Frequency	Percent	Valid Percent	Cumulative %
N/A	5	15.6	15.6	15.6
Material quality	6	18.8	18.8	34.4
Affordability	10	31.3	31.3	65.6
Absence of interest of stakeholders	2	6.3	6.3	71.9
all of the above except lack of hsg design	1	3.1	3.1	75.0
Material. avail., affordability & client participation	1	3.1	3.1	78.1
lack of housing. design, material availability & material quality	3	9.4	9.4	87.5
Lack of hsg design, matl quality, affordability & Client P	1	3.1	3.1	90.6
Material quality & Client Participation	1	3.1	3.1	93.8
Material quality & affordability	2	6.3	6.3	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Figure 6.7 Important Factors In Not Providing Adequate Housing



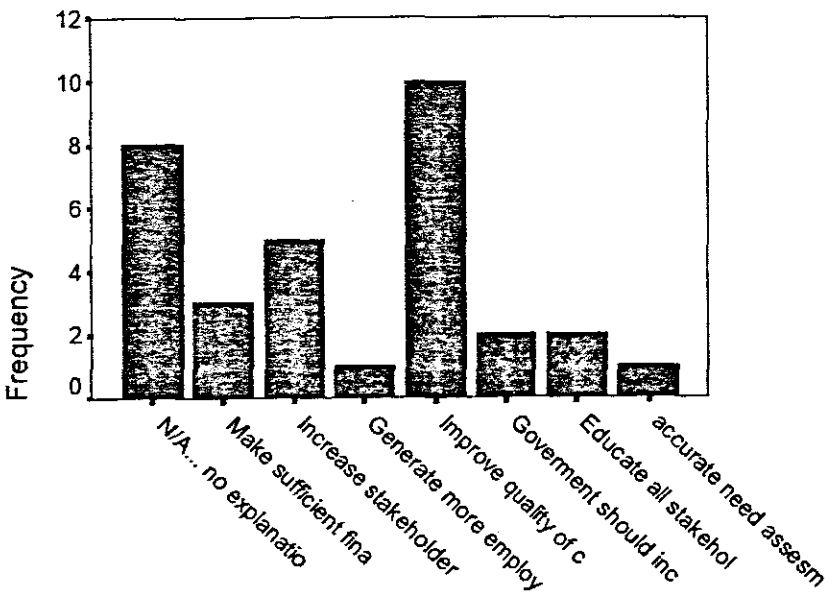
In this table, which expands on the response in Table 6.49, the perception is clear that affordability (31.3%) is considered the greatest hindrance to adequate housing, with material quality following at 18.8%. This is not surprising given that the quality of materials that can be used is predicated upon by the financial subsidy available. It is significant that 15.6% indicate that they have no viewpoint, which may mean ignorance on the topic. This response ties in with the literature review in chapter three, where the importance of affordability to shelter consumption is presented. The 15.6% without an opinion has serious implication for the environment and the more reason why education on the merits of recycling is important.

Additionally, it also indicates the need to encourage recycling as a measure of enhancing affordability because of the likely impact on overall construction cost.

Table 6.51 Requirements in order to change low-cost housing to adequate housing

Valid	Frequency	Percent	Valid Percent	Cumulative %
N/A... no explanation given	8	25.0	25.0	25.0
Make sufficient finance available to end-user	3	9.4	9.4	34.4
Increase stakeholders' participation	5	15.6	15.6	50.0
Generate more employment opportunities	1	3.1	3.1	53.1
Improve quality of construction &maintain low-cost	10	31.3	31.3	84.4
Government should increase housing subsidy	2	6.3	6.3	90.6
Educate all stakeholders regarding innovate housing technology	2	6.3	6.3	96.9
accurate need assessment & consultation w. stakeholders	1	3.1	3.1	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Figure 6.8 Requirements in order to change low-cost housing to adequate housing



The responses received to this question are interesting in that they display a keen understanding by the respondents of the remedial action required for alleviating the problems of affordability. Thus 31.3% indicate that the solution is to be found in the improvement of quality. However, the same respondents demand improvement to quality but without additional cost. It is not surprising that 15.6% feel that greater involvement and participation by the community in housing provision is required. This is supported in the literature review. This could act as an enabling mechanism for recycling as participation implies acceptance, if recycling is mooted as a means of reducing cost.

A high response in the "no explanation" area, once again indicates lack of knowledge or concern. Here again the literature review in chapter three is reinforced.

Table 6.52 Alternative housing methods & innovative material usage can result in developing adequate housing.

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	17	53.1	53.1	53.1
Perhaps	12	37.5	37.5	90.6
No	3	9.4	9.4	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

The response in Table 6.52, in which alternative housing methods and innovative material use is targeted, reveals that this concept was supported by 53.1%, with a further 37.5% indicating that this could possibly be a feasible means of adequate shelter delivery. In this instance it would be important to note the implication of increased material demand for housing improvement on the physical environment hence the need to encourage recycling as an alternative material. This should facilitate housing supply and enable reductions in the housing backlog.

However due to the introduction of the concept of "innovative material" in the question, it is implied that as in the case of recycling, community acceptance through participation would promote the actual implementation of methods and material usage referred to in this question.

Table 6.53 Consider Recycled Material As An Alternative Method Of Housing Material Provision

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes, only if end result is SABS approved	16	50.0	50.0	50.0
Perhaps	7	21.9	21.9	71.9
No	8	25.0	25.0	96.9
N/A	1	3.1	3.1	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Table 6.54 Consider Recycling In Planning Stage Of Contract

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	12	37.5	37.5	37.5
No	11	34.4	34.4	71.9
N/A	9	28.1	28.1	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Table 6.55 Consider Recycling In Planning Stage Of Contract

Valid	Frequency	Percent	Valid Percent	Cumulative %
No response	1	3.1	3.1	3.1
Yes	1	3.1	3.1	6.3
Perhaps	13	40.6	40.6	46.9
No	2	6.3	6.3	53.1
N/A	15	46.9	46.9	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Tables 6.53, 6.54 and 6.55, explore the perception of professional stakeholders regarding recycling and recycled materials. In Table 6.53 the indication is that 50% of the respondents would use recycled material only if it could have a South African Bureau of Standards (SABS) approval certificate. About 28% indicate definite aversion to the use of recycled material. In Table 6.54 only 37.5% would consider the process of recycling in

the planning stages of the contract, indicating that in fact recycling is in terms of South Africa not considered favorably as was also indicated in the cases presented in the chapter on recycling in the literature review.

Table 6.55, which required a response in terms of intention regarding attitude towards recycling in the planning stage showed that only 3.1% of the negative respondents would consider recycling positively. This indicates a considerable amount of promotional work, which should take place in order to foster the recycling process.

Tables 6.56 and 6.57 targets specifically suppliers with the aim of establishing their inclination to commercially promote recycled or used materials and further aims at establishing the type of recycled or used materials which suppliers are prepared to carry. Tables 6.56 indicate a very low (18.8%) positive response to carrying this type of material, 34.4% are indecisive, with 46.9% not being favorable to carrying recycled materials. Thus its not surprising that in Table 6.57 about 53.1% found this question irrelevant and only 46.9% were prepared to carry a variety of items, which would be recycled materials. This again coincides with the findings in the literature review, which showed that in terms of recycling more efforts are needed to encourage all the stakeholders towards recycling.

Table 6.56 Consider Carrying Recycled/Used Material As Stock Item

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	6	18.8	18.8	18.8
Perhaps	11	34.4	34.4	53.1
No	9	28.1	28.1	81.3
N/A, don't stock material	6	18.8	18.8	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Table 6.57 Material/Components Included In Stock

Valid	Frequency	Percent	Valid Percent	Cumulative %
N/A	17	53.1	53.1	53.1
Bricks	1	3.1	3.1	56.3
Blocks	1	3.1	3.1	59.4
Concrete	3	9.4	9.4	68.8
Timber	1	3.1	3.1	71.9
all of the above	3	9.4	9.4	81.3
all of the above except concrete	1	3.1	3.1	84.4
all of the above except timber	1	3.1	3.1	87.5
bricks, blocks, windows & doors	3	9.4	9.4	96.9
bricks, blocks & iron/metal	1	3.1	3.1	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Tables 6.58, 6.59 and 6.60 are posed with the intention of establishing the perception of professional stakeholders towards the potential of recycled materials. Thus Tables 6.58, which establishes the economic viability of recycled materials found that 59.4% responded positively to the economic viability potential of recycled materials and a further 31.3% indicated that this might be possible, and only 9.4% responded negatively to this question.

The same kind of responses were forthcoming in Table 6.59 with 68.8% responding positively, 21.9% stating that this might be the case and again 9.4% responding negatively to the poser that a substantial potential market exists for recycled materials. Of the negative responses 78.1% expressed disinterest in recycled materials as shown in Table 6.60, and the remainder cited either company policy, the economy or the environment for not wanting to use recycled materials, thereby reinforcing once again the findings in the literature review chapter.

Table 6.58 Recycled Material Considered As Economically Viable (Generate Income)

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	19	59.4	59.4	59.4
Perhaps	10	31.3	31.3	90.6
No	3	9.4	9.4	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Table 6.59 A Substantial Potential Market For Recycled Material

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	22	68.8	68.8	68.6
Perhaps	7	21.9	21.9	90.6
No	3	9.4	9.4	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Table 6.60 If You Said Maybe/No, Motivate?

Valid	Frequency	Percent	Valid Percent	Cumulative %
no reason given	4	12.5	12.5	12.5
N/A	21	65.6	65.6	78.1
due to unacceptable quality of material	3	9.4	9.4	87.5
the level of economic status is a deciding factor	1	3.1	3.1	90.6
Conservation of natural resources, & economical advantages	1	3.1	3.1	93.8
depends on management structure in place	2	6.3	6.3	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Tables 6.61 and 6.62 concern the likely enabling policy, thus in Table 6.61 the enabling characteristic of specification writing is directly targeted regarding the use of recycled materials in future housing provision. The findings of the data indicate that from the perception of professional stakeholders 46.9% believe that recycled materials could form part of the specifications for future housing provision. However, 37.5% perceive this to be possible while 15.6% decisively do not see recycled materials as forming part of future housing specifications.

Table 6.62, which were the responses to future policy regarding the salvaging of materials for reuse or recycling indicate that 53.1% definitely felt that this should form part of future policy. Nevertheless, 15.6% indicate a definite negative response and a further 31.3% indicate that such policy should perhaps form part of general contract

conditions. These responses indicate a positive attitude amongst the professional bodies regarding recycling and agree with the successful cases discussed in the recycling chapter in the literature review.

Table 6.61 Recycled Material Form Part Of Specifications For Future Housing Provision

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	15	46.9	46.9	46.9
Perhaps	12	37.5	37.5	84.4
No	5	15.6	15.6	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Table 6.62 Future Policy Include For Salvage Of Reuse/Recyclable Material

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	17	53.1	53.1	53.1
Perhaps	10	31.3	31.3	84.4
No	5	15.6	15.6	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Tables 6.63, 6.64 and 6.65 form a summation group geared to establish firstly in Table 6.63; what should inform policy to familiarise the public with the practise of recycled materials. It was the perception of the respondents that four areas would best be suited as a location for recycled material depot. These would be construction sites (18.8% response), near squatter areas (31.3%), acceptable Central Business Districts (21.9%) and in Municipal store yards (12.5% response).

Table 6.64 determined to establish whether recycled materials contributed towards sustainable construction. The response indicated that 56.3% of the respondents perceived recycled materials to be able to positively contribute to sustainable construction with 40.6% believing that this might be the case and only 3.1% feeling that recycled materials have no contribution to make.

In Table 6.65, which targeted the attitude of potential housing consumers towards recycled or reusable materials, the professional stakeholders 65.6% responded positively while 31.3% think that this might be the case. Only 3.1% responded negatively in terms of whether recycled material would be acceptable for use in housing construction by potential housing consumers. This response therefore shows that as was established in the literature review that recycling if readily available would form an important part of future housing construction under acceptable conditions.

Table 6.63 Indicate The Best Location For Recycled Material Depot

Valid	Frequency	Percent	Valid Percent	Cumulative %
Construction sites	6	18.8	18.8	18.8
Near squatter areas	10	31.3	31.3	50.0
In acceptable CBD areas	7	21.9	21.9	71.9
In municipal store yards	4	12.5	12.5	84.4
all of the above except CBD areas	1	3.1	3.1	87.5
construction sites & municipal store yards	1	3.1	3.1	90.6
Municipal dump sites	1	3.1	3.1	93.8
All of the above (1-4)	2	6.3	6.3	100.0
Total	32	100.0	100.0	
Total	**32**	**100.0**		
Valid Cases = 32; Missing Cases = 0				

Table 6.64 Use Of Recycled Material Contribute To Sustainable Construction

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	18	56.3	56.3	56.3
Perhaps	13	40.6	40.6	96.9
No	1	3.1	3.1	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

Table 6.65 Use Of Recycled/Reusable Material For Housing Construction Would Be Acceptable To Potential Housing Consumers

Valid	Frequency	Percent	Valid Percent	Cumulative %
Yes	21	65.6	65.6.	65.6
Perhaps	10	31.3	31.3	96.9
No	1	3.1	3.1	100.0
Total	32	100.0	100.0	
Total	32	100.0		
Valid Cases = 32; Missing Cases = 0				

For the sake of continuity and flow in the empirical analysis of the data generated by the questionnaires, a cross tabulations exercise has been added into the appendix at the end of the work. Significant amongst them is the cross tabulation done between the unemployed, the environment as well as the experience of recycling amongst professional bodies and the homeowners. As can be expected there is very little experience of recycling indicated amongst the unemployed due to their inability to purchase materials and hence poverty. This ties in with the findings on the affordability section in the chapter on housing.

When the information regarding the identity of the sample is considered especially when the sex of the homeowners is taken into account and cross tabulated with the question on satisfaction with the built environment, the majority of our sample responded positively.

However, it must be noted that these are predominantly female while 52 of those responding negatively were male. The fact that more of the female population of the sample are satisfied with the area in general terms could be indicative of the stability which accompanies homeownership, especially in situations where children are also involved

In specific terms, it is noteworthy that of those in formal employment 70.7% feel that the environment is important, whilst of those in informal employment 53.8% feel that the environment is not important. These tendencies are further reinforced when the importance of the environment is compared with homeownership. This pattern further flows into experiences with materials, except that in the case of the employed the perception is not particularly biased towards the use of recycled materials. There seems to be a bigger tendency amongst the unemployed towards using second-hand material.
This finding is understandable given the influence of employment and income on effective demand. In terms of the professional stakeholders the attitude is fairly positive towards recycling. However when design is considered 62% of respondents do not feel committed to designing for recycling.

The cross tabulations as presented in the appendix display the attitudes and perception of the homeowners and professional construction bodies regarding the environment and the likely impact recycling would have on and the affordability of low cost housing.

6.5 Conclusion

This chapter was aimed at obtaining primary data to validate the theoretical analysis presented in the literature review and the effect upon the hypothesis to the study so that it could either be rejected or accepted. The objective was to appreciate the attitudes and perceptions of households and housing professionals towards the recycling and reuse of construction wastes, which has been asserted has the potential of enhancing affordability. The data analysis shows that there is a positive attitude of households towards recycling and to a large extent housing practitioners are positively disposed to using recycled construction wastes but have been very uncertain about households acceptance of these materials. This communication gap may explain the absence of recycled construction wastes in low-cost construction. This is particularly the case given the political reality in South Africa given its past Apartheid historical past, which may have made the prescription of recycled construction wastes by officials a very politically sensitive issue.

Thus, the findings validate the theoretical discussions in chapters 2,3 and 4, which considered issues relating to recycling, housing and the environment. It is apparent that there is a gap between potential and actual use of recycled materials. Positively though, the empirical analysis does indicate a definite willingness on the part of all the stakeholders to avail themselves to recycling and the use of recycled construction materials, which is expected to enhance affordability of low-cost housing. Generally, indications are that speedy education and awareness programmes are required to enhance the process of recycling.

CHAPTER 7:

POLICY PRESCRIPTION AND CONCLUSION TO THE STUDY

7.1 *Introduction*

Given the objectives set out in chapter one, this chapter addresses the problems of policy requirements and the envisaged strategy for achieving the stated objective. It is apparent that the focus of the work revolves around the importance of the low-cost housing situation from the point of view of the relationship between the shortage of housing delivery and the demand for building materials. Therefore in attempting to realize the housing provision certain constraints impact on the process of supplying shelter to prospective homeowners in South Africa. The findings have indicated that material resources are limited, which presents an implementation problem regarding housing supply, and secondly affordability impinges on the process given the fact that up to 68% of the population are unable to raise housing finance.

These problems are experienced globally and are the most pressing in terms of housing provision and therefore demand a holistic approach, which can be implemented in the endeavour to provide shelter as envisaged by the United Nations Centre for Human Settlements (Habitat).

This study is an attempt to present the concept of recycling as a facilitating factor, which together with other efforts could enhance affordability of low cost housing and enable the poor to ascend the housing ladder. However, effective policies are needed to facilitate recycling, which must be effectively implemented. This implies the formulation of a policy, which would be of strategic significance to recycling and reuse, of construction wastes.

A further point, which is crucial to the process of recycling, is the attitude and perception of households to conventional building methodology. Evidence presented above indicates a strong bias towards the use of new materials and a preference for conventional housing design. This situation calls for a proactive policy response that engages all the stakeholders in housing construction, delivery and consumption. Thus, an effective management approach is needed to facilitate community participation by way of ensuring educational awareness. Similarly, policies favorable to recycling and reuse of construction wastes are necessary to facilitate supply chains for recycled construction products (Richards, 1998).

7.2 **Policy: Focus and Response**

The key themes of the research are environmental sustainability and affordability, and the interface between these variables and recycling and reuse of construction materials. The potential for achieving these objectives by recycling and reuse of construction wastes must command the focus of policy makers and be reflected in policy prescriptions.

Policy therefore must take cognizance of:

- materials availability and supply
- the design process
- environmental sustainability in the building process
- waste management

However, other areas of the economy which should be of interest and concern is poverty alleviation through employment creation and sustained economic growth because of the simultaneous causal relationship between poverty and environmental degradation.

Effective income distribution measures should be adopted, which could materialise through progressive taxation and housing subsidies. The endemic poverty and its the concentration within the low-income groups make effective income redistribution a necessary prerequisite to economic growth and environmental sustainability in South Africa.

7.3.1 Policy to render recycled materials available

For recycling and reuse of construction waste to become a popular and regular activity, regular supply must be guaranteed. There have to be incentives directed at demolition companies and building owners to demolish buildings with the view to recycling and reuse. The current situation where most construction wastes end up in landfill neither enables housing affordability or environmental sustainability. In terms of policy formulation the requirements would be for the provision of suitable incentives to create markets for recycled construction wastes with an effective supply chain as earlier referred to above.

However, it would be required, for the recycled market to thrive that standards' specification for construction materials be revised. Currently, standards are biased in favour of the applicant and unless this is reversed, the market for recycled materials is likely to collapse. It may require that quality ratings based on the technical performance of recycled materials to be produced. This would facilitate better response and attitude towards recycled materials.

In terms of services, policy should also focus on materials accessibility, which preferably should be located as conveniently as possible to consumers. Similarly, communities in general and the low-income in particular should be empowered to see recycled construction materials in positive lights. This is likely to attract more retailers onto the market as the risk associating with trading in recycled construction materials are likely to reduce with increased demand. Furthermore, demand for recycled construction products would be bolstered if the government was to stipulate its use within its funded projects.

7.3.2 Design Formulation

Policy in terms of design formulation should address the role of the designer with the emphasis placed on environmentally sustainable designs where the ethos of recycling and reuse feature prominently in designs. Such a move would cater for possible future demolition and as a result, designs that facilitate demolition with a view to reuse is emphasised.

7.3.3 Waste Management

The policy in this case should be two pronged; firstly it should be geared towards the construction process in order to ensure minimal construction waste. Secondly, policy must be directed towards educating construction professionals, clients, and users as to the wider benefits of environmental sustainability. Efforts must be expended to reverse the culture of waste generation and the need to encourage individual households to adopt environmentally friendly lifestyle.

7.4 *Strategic Implementation*

In terms of defining the strategy, which would ensure the effective implementation of the recycling system, a series of empowering actions and activities are required to ensure that the process is enacted in the most beneficial way for the community and the environment. In terms of this definition it would be necessary to ensure that the holistic approach to environmental sustainability mooted earlier should be given serious consideration. However, an overriding prerequisite is the presence of effective and functional institutions to ensure that government policies on recycling and reuse are implemented and regularly monitored and improved. This should involve common standards and policies across all levels of government in order that common services are offered to households.

7.5 Conclusion

The analysis above overwhelmingly shows that attitudes towards recycling and reuse of construction wastes are positive but that there are overwhelming obstacles, which must be contended with. In order that recycling and reuse becomes a reality and thereby enhances housing affordability and environmental sustainability, the government has to be involved in the process. The role earmarked for the government is an enabling one, which should create the necessary environment for recycling and reuse of construction waste to thrive. This can be done through the use of subsidies and grants to internalise associated externalities.

This can also be achieved by legislation but such a command and control measure is generally considered to be relatively inefficient for its inherent inflexibility. Nevertheless, it can be combined with incentive policy instruments to provide a 'stick as well as a carrot' for construction practitioners.

Generally, the study has shown, by the literature reviewed that there is an acute housing shortage in South Africa, which was also shown to be similar to global trends. In satisfying this basic fundamental human right, given the growing rise in population and the attendant implications for household formation, implies the imposition of huge burdens on the biophysical environment of South Africa. The study further shows that the high unemployment and poverty in prevalent South Africa, which has adverse effects on housing affordability, compound this problem. The study further shows that the huge construction wastes generated annually in South Africa, which are currently used as landfills could be recycled and reused in low-cost housing construction. The potentials for enhancing housing affordability while at the same time contributing significantly to environmental sustainability from reductions in the demand for new construction materials are huge. The recommendation is that the role of the government in ensuring the recycling and reuse of construction wastes is overwhelming but this role should be proactive and enabling.

REFERENCES

Aboutorabi, M. and Abdelhalim, K. (2000). *A study of housing affordability for low-income households in Khayelitsha Township, South Africa.* International Conference on Strategies for Sustainable Built Environment, Pretoria, South Africa 23-25 August 2000.

Adebayo, P. and Adebayo P. (2000). *Towards the Development of Humane Architecture and Habitat – a Critique of African Cities.* Paper Presented at the Urban Future 2000 International Conference on Issues Confronting the City at the Turn of the Millennium, Johannesburg, South Africa.

Adepoju, A.(1983). *Population and Space in Africa*, Proceedings of the *Second African Population Conference, United Nations Fund for Population Activities and the Government of the United Republic of Tanzania.* (Arusha Tanzania) January, p 82 Table1

African National Congress (1994), *Reconstruction and Development Programme Document.* 6th Edition, Johannesburg, South Africa.

Andela Pulverizer System (1999) *Glass Recycling, Doing It Profitably,* by Andela Tool and Machine Inc. New York, USA.

Asthana, A & Ramana Rao, N. (1989) *Applications of Fibre-glass Reinforced Plastics in Building and Construction Industry.* in Innovative Housing Practices. Proceedings of the IAHS World Congress on Housing, Portugal. Pergamon Press, Oxford, UK.

Baggs, S. and Baggs J. (1996) *The health House.* Thames and Hudson Publishers, Great Britain

Beatie, K., Molloy, L, Ward, I. (1998) *Intelligent Environmental Modelling of Building Performance for Sustainable Design.* in Materials and Technologies for Sustainable

Construction, Volume 4. *Management and Organisation.* pp 1777- 1784, CIB World Building Congress Gävle, Sweden

Bentil K.K. and Herbsman Z. (1989) *Impediments to Affordable Housing* , Proceedings of the IAHS World Congress on Housing , University of Porto, Portugal, 23 – 27 October, 1989 (Pg. 17 – 22) Pergamon Press Oxford

Benting, A (1999) *The Impact of Socio- Economic Conditions on Domestic Solid Waste Management.* Centre of Infrastructure Planning, University of Stuttgart, Germany.

Bourke K. & Soronis, G. (1998) *A Proposed Standard for Service Life of Buildings: Part 3 Auditing Systems.* in Materials and Technologies for Sustainable Construction, Volume Construction Industry Environmental Forum. Waste Minimisation and Recycling in Construction: The Demolition Process. Discussion notes from workshop meeting 28th June 1994. In CIEF Bulletin, October

Blunden, J. and Reddish, A. (1991), *Energy, Resources and Environment.* Hodder and Stoughton Publishers, London.

Bridgam, D. *et al.*, (April, 1997), *The Western Cape Economy on the way towards Global Competitiveness with Social Stability.* Wesgro Project Team , South Africa.

Burberry, P. (1970), *Environment and Services.* Batsford Ltd, Great Britain

Cakin, S. (1989) *Traditional Housing Patterns in Saudi Arabia: Lessons for Contemporary Planning and Design Practice.* in Innovative Housing Practices. Proceedings of the IAHS World Congress on Housing, Portugal. Pergamon Press.

Carliner, M. (1989) *Regulatory Costs and Affordable Housing.* Washington D.C. : Housing Economics, Volume XXXVII, No 4, p9.

Chartered Institute of Building (CIOB) (1987), *Building materials for low -income housing*. E.& F.N. Spon Ltd. Great Britain

Chartered Institute of Building (1990), *Maintenance management* – a guide to good practice. 3rd Edition.

CIB, (1997) *Information Bulletin. No.* 4/97

Cock, J. and Koch, E. (1991), *Going Green: People, politics and the environment in South Africa.* Oxford University Press, United Kingdom.

Cowan, H.J. (1984), *Energy Conservation in the Design of Multi- Storey Buildings.* Pergamon Press, Australia.

Crowe, D. (1989) *Mortgage Interest Rates and Housing Affordability.* Washington D.C.: Housing Economics, Volume XXXVII, No 4, p7.

CSIR, (1999) *The State of Human Settlement- South Africa, 1994-1998.* Draft Report Prepared by CSIR for the Department of Housing, September 1999.

Dean, Y. (1996) *Materials Technology* in Mitchell's Building Series, Longman, Essex England.

Department Of Housing, (1997). Annual Report

Department of Planning and the Environment, South Africa, (1978), *Energy Utilisation in South Africa.* Volume 2, Government Printer, Pretoria.

Department of Environmental Affairs and Tourism, (1999) *State of the Environment – South Africa.* Directorate Environmental Information and Reporting. October 1999.

De Vos, T.J. (1987), *Low Cost Housing.* CSIR's National Building Research Institute

Dienes, L. and Shabad, T. (1979), *The Soviet Energy System.* V.H. Winston and Sons Publishers, Washington D.C.

Department of Housing, (1997) *Annual Report: Housing Subsidies And Peoples Housing Process.* 1997, p14

Dessy, P., Badalucco, C., et al., (1998) *Analysis of the Performances of Concrete Components Made with Recycled Aggregates.* in Materials and Technologies for Sustainable Construction, Volume 1. *Service Life and Durabilty* pp 149- 156, CIB World Building Congress Gävle, Sweden

Development Bank of South Africa, Urban Foundation, South African Housing Advisory Council (1992)

Devins, D.W. (1982) *Energy: It's Physical Impact On The Environment.* John Wiley & Sons Publishers, New York.

DuBose, J.R. and Pearce, A.R. (1997) *The Natural Step as an assessment tool for the built environment.* Second International Conference on Buildings and the Environment, CSTB and CIB, Vol. 2, Paris.

Easton, D. (1996) *The Rammed Earth House.* Chelsea Green Publishing Company, Vermont, USA.

Earl, Babbie and Fred Halley, (1995). *Adventures in Social Research: Data Analysis Using SPSS For Windows.* Pine Forge Press, London.

Eberhard, .A. and Van Horen,C. (1995), *Poverty and Power and the South African State.* Pluto Press, London.

Ebohon, O.J. (1996) International journal for Sustainable Development, World Ecology. *The scope and limits of sustainable development in Africa's built environment sector.* Vol.3 (1996), 1-12

Ebohon, O.J, Rodriques, A.J. (1998) *Housing Issues in Developing Countries: A Critical Appraisal of Past Policies and Outcomes.* Presented in International Conference "Shelter in Developing Countries: Policy vs Outcome" Cape Town, South Africa. November, p 58-68

Erkelens, P.A (2000) *(W063 Onelist) Affordability.* Eindhoven University of Technology, The Netherlands 14 February 2000.

Fellows, R. and Lui, A. (1997), *Research Methods for Construction.* Blackwell Science Ltd, United Kingdom.

Financial Mail (1992) *Recycling building materials: waste not, want not.* Vol. 123 Part: 13 Pg. 101 March 27.

Fink, A. (1995) *How to Sample in Surveys: Learning Objectives.* Sage Publications, London.

Fleming, F., Gardner, L. and Griffith, A. (1989) *Reducing Housing Costs: Design and Construction to Prevent Home Moisture Damage.* in Innovative Housing Practices. Proceedings of the IAHS World Congress on Housing, Portugal. Pergamon Press.

Government's Report to the Nation , (1998) *The Building Has Begun.* February 1998, Universal Web, Pretoria.

Griffith, A. (1994), *Environmental Management in Construction*, Macmillan, Houndmills.

Gürer, L. (1989) *The Purposes and Proposals in Housing Policy in Turkey.* in Innovative Housing Practices. Proceedings of the IAHS World Congress on Housing, Portugal. Pergamon Press.

Hansen, T.C. (1992), *Recycling of Demolished Concrete and Masonry.* E & FN Spon Publishers, London.

Hakkinen T. (1994), *Environmental Aspects of Building Materials.* First International Conference on Sustainable Construction, Tampa - Florida, November 6-9

Häkkinen,T. & Saari, M. (1998) *Ecological Building Design.* in Materials and Technologies for Sustainable Construction, Volume 2. *Life Cycle Analysis* pp 729- 736, CIB World Building Congress Gävle, Sweden

I.W.M.B., (1995) *Report by Integrated Waste Management Board.* California Public Affairs Office, Sacramento, Ca, USA.

I.W.M.B., (1999) *Construction and Demolition Recycling Program, Construction Product Approval Process,* for Integrated Waste Management Board. California Public Affairs Office, Sacramento, Ca, USA.

I.W.M.B., (1999) *General Waste Prevention Articles,* for Integrated Waste Management Board. California Public Affairs Office, Sacramento, Ca, USA.

I.W.M.B., (1999) *Presidio of San Francisco, Building 901,* for Integrated Waste Management Board. California Public Affairs Office, Sacramento, Ca, USA.

John, V.M and Tinker, J.A (1998) *Recycling waste as building materials.* in Materials and Technologies for Sustainable Construction, Volume 2. *Life Cycle Analysis* pp 611-616, CIB World Building Congress Gävle, Sweden

Karataş, B. and Aydinli, S. (1989) *An Appraisal Approach For the Existing Dwellings in Use.* in Innovative Housing Practices. Proceedings of the IAHS World Congress on Housing, Portugal. Pergamon Press.

Kluger, J. (2000) *Population: The big crunch.* In Time magazine Earth Day 2000.

Kloft, H. & Wőrner, J. (1998) *Investigations of Mass and Energy Flow in the Existing Building Stock.* in Materials and Technologies for Sustainable Construction, Volume 2. *Life Cycle Analysis* pp 761- 768, CIB World Building Congress Gävle, Sweden

Knoll, C., *Demolition Waste: The Urban Green File Nov/Des 1998* Vol 3 No 5., Soft Brick Media Publishers. Thorne, G. (1998) The use of construction demolition waste in the low cost housing environment.

Kweku, K., & Herbsman,B., & K. (1989) *Impediments to Affordable Housing.* in Innovative Housing Practices. Proceedings of the IAHS World Congress on Housing, Portugal. Pergamon Press.

Lebens, R. and Clarke, D. (1994), *Energy in Architecture: The European Passive Solar Handbook.* B.T Batsford Publishers, London

Leedy, P.D. (1993) *Practical Research: Planning and Design,* 5th Edition. Macmillan Publishers, New York.

Lewis, L. (1989) *The Use of Timber in Self-help Affordable housing.* in Innovative Housing Practices. Proceedings of the IAHS World Congress on Housing, Portugal. Pergamon Press.

Linden, E. (2000) *Condition Critical,* Time Magazine, *Earth Day 2000,* May 2000.

Macozoma, D.S AND Benting, A. (1990). *Construction Waste Management.* CSIR, Pretoria – South Africa

Manandhar, R. and Henao, L. (1989) *The role of Wantok in Housing the Squatters in Papua New Guinea.* . in Innovative Housing Practices. Proceedings of the IAHS World Congress on Housing, Portugal. Pergamon Press.

Markandya, A. and Richardson, J. (1993). *The Earthscan Reader* in: Environmental Economics. Castlefield Press Ltd, Great Britain

Mathews, E. (1995) *From energy – efficient building to novel aircraft* South African journal of science Vol. 91

McMullan, R. (1983), *Environmental Science in Buildings.* Macmillan Press Ltd, London.

McMullan, J.T. *et al.*, (1988), *Energy Resources.* Second Edition, Edward Arnold Publishers, Great Britain.

Merrifield, A. (1992) *The Role of the State in the Provision of Low-income Housing since the late 1980's,* Commissioned by the Built Environment Support Group, University of Natal. RSA.

Ministry of Housing, (1997) *Housing The Nation: Doing justice to deliver.* January 1997.

Moosa, V. (1999) *Environmental Factors key to sustainable development.* Construction World. November 1999 (p24, 25).

Moray Council, (1998) *Headline News – Sustainability Counts*

Morris, J. (1996), *Future Build:* Agreement, Innovation and Earth. Publication of the University of the Witwatersrand, Johannesburg.

Munasinghe, M. (1990) *Energy Analysis and Policy: Selected works.* Butterworth Publishers, London.

Myhre, L. (2000) *Towards Sustainability In The Residential Sector, A study of future energy use in the Norwegian dwelling stock.* In CIB, Information Nr.2/00, pp 40-41

NBRI Researchers (1987), *Low Cost Housing.* CSIR Research Report 642. Pretoria

Ngowi, A.B. (1996) *Bridging the Gap Between the Modern and Indigenous Construction Technologies – A Case Study of Botswana.* in Botswana Journal of Technology. (pp. 19 – 28)

Nichols, P. (1991) *Social Survey Methods:* Field Guide For Development Workers. Oxford: Oxfam.

Pugh, C. (1997) *Poverty and Progress: Reflections on Housing and Urban Policies in Developing Countries, 1976-1996.* Urban Studies, Vol. 34, No.10, 1549-1596.

Pugh, C. (1998) *Housing Sector Roles and Development Transitions for Sub Saharan Africa.* Presented in International Conference "Shelter in Developing Countries: Policy vs Outcome" Cape Town, South Africa. November, p 58-68

PWD (1998) *Green Paper, Creating an Enabling Environment for Reconstruction, Growth and Development in the Construction Industry.* Co-ordinated by the Department of Public Works, Government Printer, November

Quarrie, J. (1992), *Earth Summit '92.* The United Nations Conference on Environment and Development: Rio de Janeiro, Regency Press, London.

Richards, D. (1998) *An Integrated Approach To Sustainability, In Dimensions of Sustainability.* E. & F. Spon, Routledge, London, UK.

Rodriques, A.J. (1996) *Analysis of Township Housing in South Africa: The Case of Township in Metropolitan Cape Town.* (Unpublished M Phil Thesis)

Rosenblatt, R. (2000) *Man and Nature: All the days of the Earth.* Time Magazine , Earth Day 2000 April/ May.

Sattler, M. (1998) *A centre for Sustainable housing Technologies in Brazil.* . in Materials and Technologies for Sustainable Construction, Volume 4. *Sustainable Design and Production.* pp 2331- 2338, CIB World Building Congress Gävle, Sweden

Sheerin, J.C. (1992), *The Greenhouse Effect and Developing Countries.* Economic Development Institute of the World Bank: EDI Catalogue No 251/031

Sherratt, A.F.C. (1986), *Energy Management in Buildings.* Hutchinson Publishers, London.

Sparnicht, C.and Sheehan, B. (1999) *Welfare for Waste: How Federal Taxpayer Subsidies Waste Resources and Discourage Recycling,* for Grass Roots Recycling Network. Athens, GA, USA.

Department of Environmental Affairs and Tourism (2000), *State of the Environment, 2000.* South Africa.
Department of Environmental Affairs and Tourism (2000), *South Africa Yearbook, 2000.* South Africa.

Stokke, O. (Edited) (1991) *Sustainable Development* – Papers from the 6th EADI General Conference, Oslo, 27-30th June 1990. Boston MA: Beacon Press.

Syagga, P.M. (1995) *Housing and Environmental Problems In Third World Cities.* Presented at the Symposium on Urban Habitat: The Environment of Tomorrow, Eindhoven, February

Tembo G. (1999) *The Face of the HIV/AIDS Epidemic in Africa,* Lusaka Conference, 16 – 21 September 1999. Zambia.

The Alabama Committee (1999) *What is Agenda21.* Published by the Alabama Committee to get US out of the United Nations.

Thomas, R. (1987) *Upping the ante: how impact fees affect the industry.* Building Design and Construction Industry, p 73.

Thompson, D. (2000) *Sprawl: Asphalt Jungle* in Time magazine Earth Day 2000

Thorne, G. (2000) *Using Construction Demolition Waste for Low-cost Housing.* in Project Pro, February 2000. Pp 18-19. Monument Park, RSA.

Tipple, A.G. (1994) *Employment from Housing: A resource for rapidly growing urban populations.* 2nd symposium for the Urban Poor. International Convention Centre, Birmingham, UK. 11th –14th April 1994.

Tolstoy, N., Bjőrklund, C. and Carlson, P. (1998) *Material Flows in the Construction and Heavy Engineering Sector.* in Materials and Technologies for Sustainable Construction, Volume 2, *Life Cycle Analysis.* pp 857- 864, CIB World Building Congress Gāvle, Sweden

Torring, M. (1998) *Management of Construction & Demolition Waste Streams.* in Materials and Technologies for Sustainable Construction, Volume 3. Management and Organisation. pp 1911- 1918, CIB World Building Congress Gāvle, Sweden

Turner, R.K (1990), *Sustainable environmental management: principles and practice.* Westview Press, Great Britain

United Nations, Economic and Social Council, Commission on Sustainable Development, 8th session, *Report of the Inter-sessional Ad Hoc Working Group on Integrated Planning and Management of Land Resources; and on Agriculture.* New York, 28 February-3 March 2000

United Nations (1994). *Report on the World Social Situation* New York

United Nations Development Program (UNDP), (1999) Energy after Rio: Prospects and Challenges, *Energy in the United Nations Context.* 1999

The United Nations Conference on Environment and Development (UNCED), (1993). *International Law and Policy Series.* Graham and Trotman, London, 1993.

UNCHS/ILO, (1995) *Shelter Provision an Employment Generation.* Nairobi and Geneva: UNHCS and ILO.

Valente, J.P (1987) *Technology versus Development* In Innovative Housing Practices. pp 281-283. Pergamon Press, Oxford UK.

Walker, J, Hill, R, and Bowen, P. (2000). *A Sustainability Assessment Method for Greenfield, low-cost, cement block-housing developments on the Cape flats, Cape Town.* International Conference on Strategies for Sustainable Built Environment, Pretoria, South Africa 23-25 August 2000.

Ward, I *et al.*, (1998) *Intelligent Environmental Modelling of Building Performance for Sustainable Design.* CIOB

Whiteside, A, Wilkins N, Mason, B, and Wood, G. (1995). *The Impact of HIV/AIDS on Planning Issues in Kwazulu-Natal.* Town and Regional Planning Supplementary Report Vol. 42, Pietermaritzburg: Town and Regional Planning Commission.

Wlodarczyk, J.W. (1989) *New Strategy of Architectural Programming for Housing in Developing Regions.* . in Innovative Housing Practices. Proceedings of the IAHS World Congress on Housing, Portugal. Pergamon Press.

World Bank (1992). World Development Report: Development and the Environment, The World Bank, Oxford University Publishers, London.

World Bank, (1993). *Poverty Reduction Handbook.* Washington D.C.

World Bank, (1993) *Housing Enabling Markets to Work,* A World Bank Policy Paper. The International Bank for Reconstruction and Development, Washington D.C., USA

World Council for Economic Development (WCED), (1987) *Our common future*, a report under the chair of Gro Brundtland, 1987. New York: Oxford University Press

World Health Organisation (1992). Report of the Panel on Urbanisation. WHO, Geneva.

Wright, D. (1984), *Natural Solar Architecture: The Passive Solar Primer.* Third edition, Van Nostrand Reinhold Publishers, New York.

APPENDIX 1

Questionnaire

The following set of questions applies to homeowners.

6.3.1.1 Homeowners Identity Details

Q1. In which area do you stay?

Q2. What is your sex?

Q3. How many people stay in your house?

Q4. Of the people staying in your house how many are adults?

Q5. Of the people staying in your house how many are children?

Q6. How many persons are employed?

Q7. Is this employment formal or informal?

6.3.1.2 Property Type

Q8. Is your house made of the following materials?

Q9. How many rooms do you have?

Q10. How many doors do you have?

Q11. How many windows do you have?

Q12. What is the size of your house?

Q13. Do you have electricity?

Q14. Do you have running water?

6.3.1.3 Housing Affordability

Q15. Do you own your house?

Q16. What type of housing finance did you use to buy this house?

Q17. Do you require additional rooms if so how many?

Q18. Are you satisfied with the materials used for the construction of your house?

Q19. If no what material would you prefer

6.3.1.4 Environmental Issues

Q20. Are you satisfied with the area in which you are staying?

Q21. Is the area suitably developed?

Q22. What is your opinion of the state of the items mentioned in question two?

Q23. Would you say that the surrounding area is important to the quality of your life?

Q24. Rate environmental issues in terms of importance to you

Q25. Based on your answer in Q24, do you consider your environment as being a part of all your activities at home?

Q26. Do you think that there is a shortage of the following materials?

Q27. Do you think that the present rate of production of building materials can be maintained into the future?

Q28. Is the production of building materials harmful to the environment?

Q29. Would you consider different methods of house building?

Q30. Would you consider alternative materials in house building?

Q31. Would you consider using second hand building material?

Q32. Have you had any experience with the use of recycled and/ or used building

materials?

Q33. If yes which of the following materials or components have you used?

Q34. Where and how did you obtain the materials mentioned in Q33?

Q35. Do you consider recycled materials to be reasonably cheaper than new material?

Q36. Do you find recycled material to be readily available?

Q37. Will the process of recycling help in saving the natural resources?

Q38. In your opinion would recycling contribute towards reducing the cost of building your house?

The following set of questions applies to Local Authorities, Professional Designers and Suppliers

6.3.2.1 Professional Stakeholder Identity Details

Q1. Under which of the following categories would you place yourself or your firm?

Q2. Under which municipal area do you fall?

Q3. What position do you hold in your organisation?

6.3.2.2 Environmental Issues

Q4. Do you have an environmental policy in your organisation?

Q5. Is your policy attached to the Agenda21and/ or Local Agenda21?

Q6. In formulating your policy was any consultation with other stakeholders done?

Q7. If yes, was the information incorporated into your policy?

Q8. In the planning process of your organisation are strategies for sustainable development considered?

Q9. When considering new contracts is the availability of materials a deciding factor in the design process ? (Municipalities and Designers only)

Q10. In considering availability of materials would local availability be considered as being a deciding factor?

Q11. In your opinion do you feel that material availability is unlimited?

Q12. In low cost housing design would you be able to describe the end product as being adequate housing ?

Q13. If not, which of the following would you describe as being the most important factor in not providing adequate housing?

Q14. Based on your answer above what in your opinion needs to be done change low cost housing to adequate housing?

Q15. Do you think that alternative methodology and materials could be considered as facilitators in the process of narrowing the gap (if any) between current housing provision and adequate housing?

Q16. Would you consider recycling / reuse of material as an alternative method of housing material provision?

Q17. As a Designer or Local Authority do you consider recycling in the planning stage Of a contract?

Q18. If no, as a Designer or Local Authority would you consider recycling in the planning stage of a contract?

Q19. Explain the reason for your answers in Q16 and Q17.

Q20. Would you as a supplier consider carrying recycled or used material as a stock Item?

Q21. If yes which of the following materials or components would be included in your stock list?:

Q22. Do you think that recycled materials can be considered economically viable? (i.e., they can generate income)

Q23. Is there a substantial potential market for recycled materials?

Q24. If your answer to Q23 is negative (includes "maybe") why do you think this?

Q25. Do you think recycled materials can form part of the specifications for future housing provision?

Q26. Should future policy include for the salvage of reusable/recyclable material?

Q27. What in your opinion would be the best location for a recycled materials depot?

Q28. Would the use of recycled materials contribute to sustainable construction?

Q29. Do you think that the use of recycled/reusable materials can save and extend The future natural material resources especially in terms of building demand?

APPENDIX 2

(SPSS Programme)

Cross Tabulation: Homeowners

20 with 2

17 with 3

6 with 5

24 with 7,6,15

25 with 7,6,15

23 with 7,6,15

31 with 7,6,15

32 with 7,6,15

30 with 7,6,15

35 with 7,6,15

36 with 7,6,15

37 with 7,6,15

20 with 18

22 with 20

23 with 20,22,21

24 with 21

26 with 24

27 with 24

28 with 24,25,26

29 with 24,25,26

30 with 24,25,26,27

31 with 24,25,26,27

32 with 26,33,34,35,36,37,38

Cross Tabulation: - Professional Stakeholders

1 with 4,5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

18 with 17

20 with 21

22 with 20

22 with 21

23 with 20

24 with 20

24 with 1

25 with 1

26 with 1

27 with 1