1. Introduction

The World Commission on Environment and Development (WCED) (1987) defines sustainable development as "development that meets the needs of the present without compromising the ability of the future generations to meet their own." It requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life. Moffat (1994) acknowledges the holistic nature of sustainable development as well as its focus on the parts and Dahl (1997) emphasizes the definition's accountability of time and responsibility towards future generations.

Development is described (Upreti, 1994) as a process oriented at imparting the greatest improvement in the quality of people's life, social justice and equity, the improvement in human condition and the realization of human potentials. This definition is reaffirmed by Dahl's (1997) statement, that development is a durable rise in living standards and well being and not just an increase in financial value. Upreti (1994) states that development cannot be conceived to have social meaning if it is not directed to the satisfaction of human needs. The concept of sustainable development raises the need to look at all aspects of our society and its development in all its multiplicity, and to question its ability to last into the indefinite future.

Referring to the WCEDs definition of sustainable development, Nepal (1997) concludes that this concept is defined by the achievements of certain social and economic objectives and not just by measurement of the environment health. Adam (1990) states that the World Conservation Strategy [(IUCN, 1980)] started from the premise of the need to conserve ecosystems and sought to demonstrate why this made

economic sense. He further explained that *Our Common Future* [(WCED, 1987)] starts with the people and goes on to discuss what kinds of environmental policies are required to achieve socio-economic goals.

At the national, regional and global level, efforts have been made to explore sustainable development (see, for example, Reyers *et al.*, 1997 and van Jaarsveld, 1996). There is an expressed (Gibbs, 1994) concern on the little work undertaken to address the exact meaning of sustainable development at the local level. Measures taken at the local level accumulate to provide part of a global solution (Moldan, 1997), thus putting the concept of thinking globally and acting local into practice. This study aims to sensitize local authorities to include efforts directed at making sustainable development a reality as a main item on their agenda. This study attempts to collate a national database of sustainable development indicators at the scale of magisterial districts and to evaluate the existence of the relevant data at a national scale.

The purpose of the present study is to address the relationship between indicators, and to explore their use to measure the broad concept of sustainable development at a magisterial district scale. This study is motivated by the reasoning that the economic, social and the environmental dimensions are not only interdependent, but that they evolve together and will continue to evolve into the future (van Jaarsveld, 1996). In attempting to address the sustainable development challenge, this study adopts van Jaarsveld's (1996) co-evolutionary approach towards the evaluation of sustainable development.

Attempts to capture the spatial dimension in the evaluation of sustainable development indicators will be made. The need for incorporating such aspects is justified by the temporal nature of sustainable development as implied by the term development (Langaas, 1997). Gallopin (1997) also calls for the need for indicators of sustainable development to show changes through time and space, because of the inherent temporal dimension imbedded in the concept of sustainable development.

1.1 Measuring sustainable development

Dahl (1997) expressed that assembling the many specific dimensions inevitably involved in sustainable development is the challenging aspect about building a big picture of sustainable development. This approach simplifies data even further by reducing independent variables to a minimum set of indicators, thus simplifying the interpretation of the information (van Jaarsveld, 1996). Although van Jaarsveld (1996) warns that disaggregation of indicators does not guarantee good decision-making, it is acknowledged that such indicators are required to address problems specifically. This is to ensure that the real driving forces of identified problems become the targets of public policy.

The problem with this approach is that many things that are easily understood to be an essential part of development have no monetary value (Dahl, 1997). Hence Bandara (1999) states that "if we were to discard anything unquantifiable, then forget about half of the world." A representative statement of this problem is that mineral resources could be exhausted, soils eroded, aquifers polluted, and wildlife may be hunted to extinction but measured income would not be affected as these assets disappeared (Repetto *et al.*, 1989). Recognition of the multidimensional nature of sustainable development underscores the need for indicators that reflect such varied issues as income, health, basic needs, and the environment (Moldan, 1997).

The rationale for developing a sustainable development strategy is to improve the wealth, health and welfare of the population (Gibbs, 1994). Moldan (1997) admonishes that economic development cannot be the antagonist of the environment

for long and remain sustainable. Fundamental to the concept of sustainability is the need to recognize that the economy is not separate from the environment in which we and other species live (Moffat and Wilson, 1994). It is expressed (Moldan, 1997) that the best policies for environmental protection also help further economic activity. Rutherford (1997) states that industry requires human labour and human brains, as well as natural resources.

1.2 The need for indicators of sustainable development

The United Nations Commission on Sustainable Development (1996a) invited the scientific community to undertake further work on identifying and assessing the linkages among the economic, social, institutional and environmental elements of sustainable development. Principle 1 of the Bellagio Principles states (Hardi, 1997) that "assessment of progress toward sustainable development should be guided by a clear vision of sustainable development and goals that define that vision." At the workshop on Indicators of Sustainable Development (ISD) for Decision Making, in Ghent 1995, the potential uses of ISD were indicated (FPOB, 1995). Below is a list of the potential uses of ISD:

a) They can alert decision-makers to priority issues, guiding policy formulations, simplifying and improving communication (FPOB, 1995).

b) Fostering a common understanding of key trends with a view to predict future impacts of human activities on the environment and society to determine future and/or alternatives strategies and policies (Winograd, 1997).

c) They can be used to assess conditions and trends in relation to goals and targets; to compare across places and situations; and to provide early warning information (Gallopin, 1997 and Tunstall, 1992, 1994).

d) They can be useful in determining the change in the environment in relation to society and developmental process (Winograd, 1997).

e) Diagnose the actual driving forces and effects of detected problems in order to elaborate responses and actions (Winograd, 1997).

f) Sustainability indicators are useful tools for monitoring the progress that has been made on the way towards a sustainable development (Moldan and Billharz, 1997 and FPOB, 1995).

g) Within various context indicators are needed to clearly show whether we are on the right track and in what direction we are headed (Moldan and Billharz, 1997).

2. Methods

The data used were collected from various primary and secondary statistical sources in South Africa. Appendix 1 shows the sources of data used in this study and presents a list of the collected variables together with their definitions. The choice of variables included in each analysis was restricted by the availability of data. Data analyses were conducted at a magisterial district scale, collectively on 373 South African magisterial districts. Analyses were based on 40 variables, classed into three main categories comprised of 13 social, 10 economic and 17 environmental variables.

Area dependent variables were weighted by the magisterial district area (km^2) and population dependent variables by the population size of the respective magisterial districts. This procedure was conducted in order to avoid misleading results as a consequence of differences in land areas and population sizes between various magisterial districts. The data collected for this study is presented in Appendix 2.

The United Nation's Framework for Indicators of Sustainable Development (1996b) was adopted, there was further subdivision of the social, economic and environmental classes into positive and negative categories respectively (see, Appendix 3). The mean values of the positive and negative categories were calculated, in order understand the overall indication of the negative and positive indicators for the respective classes. Further the mean values of the negative indicators were subtracted from the positive indicators. The quantitative differences between the positive and negative values were used as overall performance indicators, and were recognized as indices for the respective classes.

Pearson's correlation analysis was used to quantify and explore the co-evolutionary relationships between variables without inferring any cause-effect relationships (Sokal and Rohlf, 1995). Correlation analyses was also used to explore the co-variation pattern between the data sets of positive and negative indicators with sustainable development indices. The procedure conducted to support the possible relationship between changes in sustainable development indices by positive and negative indicators respectively.

Prior to spatial analysis the classes of data sets and the respective indices were ranked in order to distill unit inconsistencies. A Geographic Information System (GIS-Arc-View) was used for data geo-referencing, an approach aimed at illustrating the general patterns of variation between the magisterial district areas. Two representative districts were sampled from each of the nine provinces of South Africa to illustrate the pattern of co-variation between positive and negative indicators, as well as indices of sustainable development.

3. Results

The results of the correlation analyses conducted between social, economic and environmental sustainable development variables for South African magisterial districts are provided in Table 1. Maps showing the GIS Arc-View presentation illustrate the general patterns of variation between various magisterial district areas. Figures illustrating the pattern of co-variation between positive and negative indicators, and indices of sustainable development are presented. The most important trends that emerge from the analyses are reported.

3.1 Social sustainable development indicators

3.1.1 Negative indicators

The results indicate a negative correlation between population density and households without access to piped water. A negative correlation appears between urban rural spread and households with access to off-site water facilities. The data indicate a negative correlation between households with access to piped water and those with access to off-site water facilities, unemployment rate and population growth rate. As expected population density displays a positive relationship with population growth rate and the urban rural spread (Table 1).

Table 1. A correlation (n = 373, $P < 0.001$) matrix between social, economic and environmental indicators for South African magisterial districts

	%FL	*AFS*	*AOW*	*APW*	*APL*	*ABL*	*ASL*	*CS*	*PGR*	*PD*
Percentage functional literacy (%FL)	1.00									
Access to full services (AFS)	**0.77**	1.00								
Access to on-site water facilities (AOW)	**0.19**	**0.23**	1.00							
Access to piped water (APW)	**0.75**	**0.96**	0.13	1.00						
Access to pit-latrine facilities (APL)	**-0.70**	**-0.92**	**-0.23**	**-0.90**	1.00					
Access to bucket latrine facilities (ABL)	**0.33**	**0.40**	**0.31**	**0.29**	**-0.36**	1.00				
Access to septic tank latrine facilities (ASL)	-0.03	0.00	**0.46**	**0.13**	-0.07	0.00	1.00			
Community services (CS)	**0.37**	**0.37**	**-0.10**	**0.41**	**-0.34**	0.01	-0.03	1.00		
Population growth rate (PGR)	0.02	**-0.15**	**-0.24**	**-0.22**	**0.18**	-0.05	**-0.36**	-0.09	1.00	
Population density (PD)	0.09	0.06	-0.07	0.01	**-0.13**	**0.19**	**-0.16**	0.02	**0.13**	1.00
No access to piped water (NAP)	**-0.68**	**-0.86**	**-0.14**	**-0.82**	**0.92**	**-0.37**	0.01	**-0.31**	0.08	**-0.15**
Access to off-site water facilities (HOF)	**-0.64**	**-0.86**	**-0.27**	**-0.87**	**0.94**	**-0.26**	**-0.14**	**-0.34**	**0.25**	-0.08
Unemployment rate (UR)	**-0.25**	**-0.34**	**-0.22**	**-0.38**	**0.38**	-0.07	**-0.23**	**-0.19**	**0.24**	-0.02
Urban rural spread (URS)	**0.23**	**0.22**	-0.07	**0.19**	**-0.19**	0.08	**-0.13**	**0.35**	-0.01	**0.15**
Arable land per capita (ALP)	0.04	**0.18**	**0.22**	**0.22**	**-0.21**	0.00	**0.29**	0.03	**-0.17**	-0.06
Species density (SD)	0.10	0.05	**-0.12**	0.01	-0.08	**0.15**	**-0.20**	-0.02	**0.20**	**0.83**
Protected areas (PA)	0.09	-0.03	-0.01	0.01	0.04	**-0.12**	0.04	-0.01	**0.21**	-0.05
Use of agricultural pesticides (UAP)	**0.35**	**0.34**	0.04	**0.32**	**-0.31**	**0.13**	-0.08	**0.17**	-0.01	-0.01
Use of fertilizers (UF)	**0.26**	**0.24**	**0.15**	**0.27**	**-0.23**	-0.01	**0.13**	0.05	-0.09	-0.05
Intensity of cattle production (ICP)	0.02	**-0.10**	**-0.12**	**-0.12**	**0.14**	-0.07	**-0.13**	-0.05	**0.10**	0.02
Intensity of maize production (IMP)	0.09	0.09	-0.05	0.09	-0.07	-0.08	-0.06	0.00	-0.01	0.09
Energy use in agriculture (EUA)	0.00	**0.10**	**0.23**	**0.12**	**-0.13**	0.02	**0.34**	-0.01	**-0.16**	-0.05
Electricity, gas and water (EW)	0.00	0.03	0.03	0.02	-0.01	-0.04	-0.01	0.03	-0.08	-0.03
Irrigation percentage of arable land (IPA)	0.02	0.01	**0.14**	0.01	-0.02	0.00	**0.11**	0.02	-0.04	-0.01
Income from livestock (IL)	0.02	0.09	**0.19**	0.13	**-0.11**	-0.05	**0.25**	-0.01	**-0.21**	-0.07
Agriculture, fishing and forestry (AFF)	0.01	0.09	**0.24**	**0.17**	**-0.13**	0.02	**0.47**	0.05	**-0.28**	-0.09
Income from field crops (IFC)	-0.01	0.05	**0.15**	0.08	-0.07	**0.11**	**0.48**	0.01	**-0.14**	-0.05
Income from horticulture (IH)	0.03	0.04	**0.18**	0.08	-0.06	-0.07	**0.21**	-0.01	**-0.10**	-0.05
Mining intensity index (MI)	**0.29**	**0.26**	-0.03	**0.23**	**-0.24**	**0.15**	**-0.15**	**0.13**	0.02	0.03
Mining and quarrying (MQ)	0.03	0.06	0.05	0.07	-0.06	0.01	0.07	-0.01	-0.06	-0.02
Potential labor force (PLF)	0.01	0.05	0.05	0.08	-0.05	-0.06	**0.12**	0.00	**-0.12**	-0.04
Paid employees in agricultural sector (PEA)	0.03	**0.12**	**0.27**	**0.19**	**-0.15**	0.04	**0.48**	0.01	**-0.28**	**-0.10**
Gross remuneration of employees (PAY)	0.04	0.08	0.09	0.07	-0.07	-0.06	0.05	0.04	**-0.11**	-0.02
Trade and catering (TD)	0.05	0.05	0.04	0.05	-0.05	0.08	0.06	-0.01	-0.02	-0.03
Finance and real estates (FRE)	0.04	0.04	0.04	0.04	-0.04	0.07	0.05	-0.02	-0.02	-0.02
Transport and communication (TC)	0.05	0.10	0.08	0.08	-0.09	-0.06	0.01	0.08	-0.09	-0.01
Other producers (OP)	0.03	0.04	0.06	0.06	-0.05	0.05	0.09	-0.01	-0.04	-0.03
Manufacturing (M)	0.04	0.08	0.04	**0.10**	-0.08	0.07	**0.11**	0.00	-0.05	-0.03
Construction (C)	0.02	0.06	0.06	0.08	-0.06	0.01	**0.13**	-0.01	-0.06	-0.03
Poverty gap (PG)	**-0.34**	**-0.39**	**-0.20**	**-0.38**	**0.34**	**-0.25**	-0.07	-0.07	0.09	-0.07

Table 1. *Continued*

	NAP	*HOF*	*UR*	*URS*	*ALP*	*SD*	*PA*	*UAP*	*UF*	*ICP*
Percentage functional literacy (%FL)										
Access to full services (AFS)										
Access to on-site water facilities (AOW)										
Access to piped water (APW)										
Access to pit-latrine facilities (APL)										
Access to bucket latrine facilities (ABL)										
Access to septic tank latrine facilities (ASL)										
Community services (CS)										
Population growth rate (PGR)										
Population density (PD)										
No access to piped water (NAP)	1.00									
Access to off-site water facilities (HOF)	**0.75**	1.00								
Unemployment rate (UR)	**0.24**	**0.46**	1.00							
Urban rural spread (URS)	**-0.20**	**-0.16**	-0.02	1.00						
Arable land per capita (ALP)	**-0.18**	**-0.21**	**-0.10**	-0.04	1.00					
Species density (SD)	**-0.12**	-0.02	-0.02	0.05	**-0.12**	1.00				
Protected areas (PA)	0.02	0.03	0.00	-0.03	-0.04	-0.04	1.00			
Use of agricultural pesticides (UAP)	**-0.28**	**-0.30**	**-0.21**	0.09	**-0.10**	-0.02	-0.02	1.00		
Use of fertilizers (UF)	**-0.18**	**-0.26**	**-0.27**	-0.04	**-0.11**	0.02	0.01	**0.24**	1.00	
Intensity of cattle production (ICP)	**0.11**	**0.14**	0.04	0.03	**-0.12**	**0.19**	0.03	0.09	**0.15**	1.00
Intensity of maize production (IMP)	-0.08	-0.06	-0.05	-0.01	-0.04	**0.19**	-0.02	-0.01	0.06	0.02
Energy use in agriculture (EUA)	**-0.10**	**-0.14**	**-0.11**	-0.04	**0.18**	-0.07	0.01	-0.03	0.03	-0.05
Electricity, gas and water (EW)	-0.01	-0.02	-0.09	0.00	-0.04	-0.02	-0.01	0.01	0.06	0.01
Irrigation percentage of arable land (IPA)	-0.02	-0.03	-0.06	-0.01	0.00	-0.02	0.03	-0.01	-0.02	-0.03
Income from livestock (IL)	-0.05	**-0.14**	**-0.18**	-0.05	**0.16**	-0.08	0.02	**0.10**	**0.17**	-0.05
Agriculture, fishing and forestry (AFF)	-0.06	**-0.17**	**-0.21**	-0.07	**0.24**	**-0.10**	0.02	0.01	**0.15**	-0.03
Income from field crops (IFC)	-0.05	-0.08	**-0.12**	-0.04	**0.12**	-0.06	0.03	-0.02	**0.13**	-0.06
Income from horticulture (IH)	0.00	**-0.11**	**-0.21**	-0.04	0.03	-0.04	0.06	-0.01	0.05	0.00
Mining intensity index (MI)	**-0.23**	**-0.21**	**-0.13**	**0.19**	-0.08	-0.01	-0.05	**0.43**	0.02	0.04
Mining and quarrying (MQ)	-0.05	-0.07	**-0.10**	-0.01	0.02	-0.04	-0.03	0.04	-0.02	-0.04
Potential labor force (PLF)	-0.05	-0.05	-0.01	-0.03	-0.02	-0.02	0.00	-0.03	-0.05	0.04
Paid employees in agricultural sector (PEA)	-0.09	**-0.19**	**-0.23**	-0.07	**0.33**	-0.09	0.02	-0.04	**0.15**	0.00
Gross remuneration of employees (PAY)	-0.06	-0.08	-0.08	0.01	-0.02	0.00	-0.01	-0.01	-0.03	0.03
Trade and catering (TD)	-0.04	-0.05	-0.05	-0.02	0.02	-0.04	-0.03	-0.02	0.03	-0.03
Finance and real estates (FRE)	-0.03	-0.04	-0.04	-0.02	0.01	-0.04	-0.03	-0.01	0.03	-0.03
Transport and communication (TC)	-0.08	-0.09	-0.07	0.04	-0.02	0.00	-0.01	-0.02	-0.02	0.02
Other producers (OP)	-0.04	-0.05	-0.02	-0.02	0.04	-0.05	-0.03	-0.02	0.01	-0.04
Manufacturing (M)	-0.08	-0.08	-0.03	-0.02	0.07	-0.04	-0.04	-0.04	0.02	-0.05
Construction (C)	-0.06	-0.07	0.00	-0.02	0.07	-0.05	-0.04	-0.03	-0.01	-0.04
Poverty gap (PG)	**0.29**	**0.33**	**0.26**	-0.07	0.02	-0.06	**0.32**	**-0.16**	**-0.19**	0.06

Table 1. *Continued*

	IMP	*EUA*	*EW*	*IPA*	*IL*	*AFF*	*IFC*	*IH*	*MI*	*MQ*
Percentage functional literacy (%FL)										
Access to full services (AFS)										
Access to on-site water facilities (AOW)										
Access to piped water (APW)										
Access to pit-latrine facilities (APL)										
Access to bucket latrine facilities (ABL)										
Access to septic tank latrine facilities (ASL)										
Community services (CS)										
Population growth rate (PGR)										
Population density (PD)										
No access to piped water (NAP)										
Access to off-site water facilities (HOF)										
Unemployment rate (UR)										
Urban rural spread (URS)										
Arable land per capita (ALP)										
Species density (SD)										
Protected areas (PA)										
Use of agricultural pesticides (UAP)										
Use of fertilizers (UF)										
Intensity of cattle production (ICP)										
Intensity of maize production (IMP)	1.00									
Energy use in agriculture (EUA)	-0.01	1.00								
Electricity, gas and water (EW)	0.03	0.05	1.00							
Irrigation percentage of arable land (IPA)	-0.01	-0.01	0.00	1.00						
Income from livestock (IL)	0.00	**0.35**	**0.41**	0.06	1.00					
Agriculture, fishing and forestry (AFF)	-0.02	**0.47**	**0.16**	0.04	**0.58**	1.00				
Income from field crops (IFC)	0.03	**0.43**	0.05	0.00	**0.29**	**0.60**	1.00			
Income from horticulture (IH)	-0.03	**0.18**	**0.12**	0.00	**0.29**	**0.43**	**0.16**	1.00		
Mining intensity index (MI)	0.07	-0.06	0.01	-0.02	-0.06	**-0.11**	-0.02	-0.06	1.00	
Mining and quarrying (MQ)	-0.01	0.00	0.07	0.00	0.08	0.06	0.03	**0.10**	0.00	1.00
Potential labor force (PLF)	-0.02	**0.10**	**0.43**	0.00	**0.23**	**0.27**	0.07	**0.17**	-0.06	**0.51**
Paid employees in agricultural sector (PEA)	-0.01	**0.46**	0.09	0.05	**0.44**	**0.79**	**0.64**	**0.41**	-0.08	0.07
Gross remuneration of employees (PAY)	-0.01	0.08	**0.57**	0.00	**0.38**	**0.21**	0.02	**0.22**	-0.03	**0.23**
Trade and catering (TD)	0.04	0.03	-0.02	-0.01	0.01	0.04	0.08	0.02	-0.02	-0.02
Finance and real estates (FRE)	0.05	0.02	-0.02	-0.01	0.01	0.03	0.06	0.00	-0.02	-0.02
Transport and communication (TC)	-0.02	0.06	**0.51**	0.00	**0.36**	**0.15**	0.01	**0.17**	-0.02	0.04
Other producers (OP)	0.03	0.05	-0.02	-0.01	0.04	**0.10**	0.07	0.02	-0.03	-0.02
Manufacturing (M)	0.00	**0.12**	-0.03	-0.01	0.06	**0.21**	**0.22**	0.06	-0.02	-0.02
Construction (C)	0.01	0.06	-0.02	-0.01	0.05	**0.15**	0.06	0.04	-0.03	-0.02
Poverty gap (PG)	-0.05	-0.02	**0.12**	-0.01	0.07	-0.02	-0.01	-0.01	-0.08	-0.02

Table 1. *Continued*

	PLF	*PEA*	*PAY*	*TD*	*FRE*	*TC*	*OP*	*M*	*C*	*PG*
Percentage functional literacy (%FL)										
Access to full services (AFS)										
Access to on-site water facilities (AOW)										
Access to piped water (APW)										
Access to pit-latrine facilities (APL)										
Access to bucket latrine facilities (ABL)										
Access to septic tank latrine facilities (ASL)										
Community services (CS)										
Population growth rate (PGR)										
Population density (PD)										
No access to piped water (NAP)										
Access to off-site water facilities (HOF)										
Unemployment rate (UR)										
Urban rural spread (URS)										
Arable land per capita (ALP)										
Species density (SD)										
Protected areas (PA)										
Use of agricultural pesticides (UAP)										
Use of fertilizers (UF)										
Intensity of cattle production (ICP)										
Intensity of maize production (IMP)										
Energy use in agriculture (EUA)										
Electricity, gas and water (EW)										
Irrigation percentage of arable land (IPA)										
Income from livestock (IL)										
Agriculture, fishing and forestry (AFF)										
Income from field crops (IFC)										
Income from horticulture (IH)										
Mining intensity index (MI)										
Mining and quarrying (MQ)										
Potential labor force (PLF)	1.00									
Paid employees in agricultural sector (PEA)	**0.17**	1.00								
Gross remuneration of employees (PAY)	**0.71**	**0.15**	1.00							
Trade and catering (TD)	-0.01	0.05	-0.01	1.00						
Finance and real estates (FRE)	0.00	0.03	-0.01	**0.98**	1.00					
Transport and communication (TC)	**0.50**	**0.11**	**0.87**	-0.01	0.00	1.00				
Other producers (OP)	0.03	**0.11**	0.00	**0.88**	**0.93**	0.00	1.00			
Manufacturing (M)	0.03	**0.22**	-0.01	**0.70**	**0.69**	-0.01	**0.82**	1.00		
Construction (C)	0.07	**0.15**	0.00	**0.56**	**0.64**	0.00	**0.84**	**0.80**	1.00	
Poverty gap (PG)	0.08	0.00	0.04	-0.06	-0.05	0.02	-0.03	-0.01	0.00	1.00

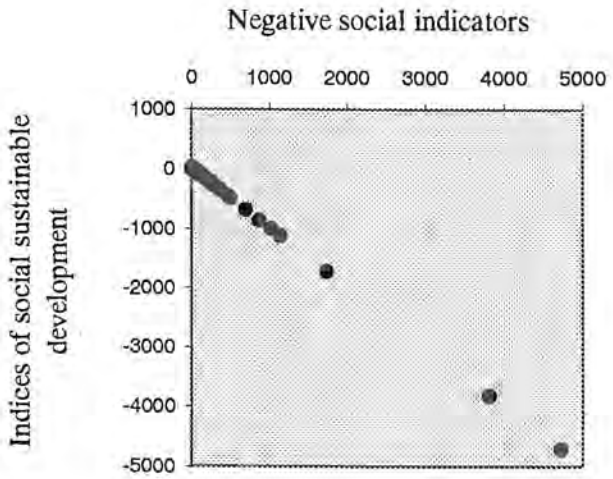

Figure 1. Correlation between the negative social indicators and the indices of social sustainable development

Figure 1 indicates the relationship between the negative indicators and the social sustainable development indices. The results indicate a very high significant ($r^2 = 1.0$, $P = < 0.001$, $n = 373$) co-variation between the data sets of negative social indicators and the social sustainable development index.

Figure 2 shows the results of the data of negative social sustainable development indicators (see, Appendix 3). Each polygon on the map represents a South African magisterial district. As presented in the legend, the variation patterns range from districts indicating very low negative values to those indicating very high negative values. Districts that are indicated by very high negative values represent the South African magisterial districts with the greatest percentage of off-site water facilities and without access to piped water, the greatest urban-rural spread, greatest population density and highest unemployment rates.

Magisterial districts with the lowest percentage of functional literacy, and the highest percentage of households with poor access to water and latrine facilities are found in the Eastern Cape, KwaZulu Natal and North West Province. In the Eastern Cape, KwaZulu Natal, Gauteng, North West and Northern Province a high percentage of districts are characterized by highest population densities and unemployment rate. In the Eastern Cape, KwaZulu Natal, Gauteng, North West and Northern Province many magisterial districts show the highest urban-rural spread (Figure 2 and 3). The map indicating the location of South African Provinces is presented in Appendix 4.

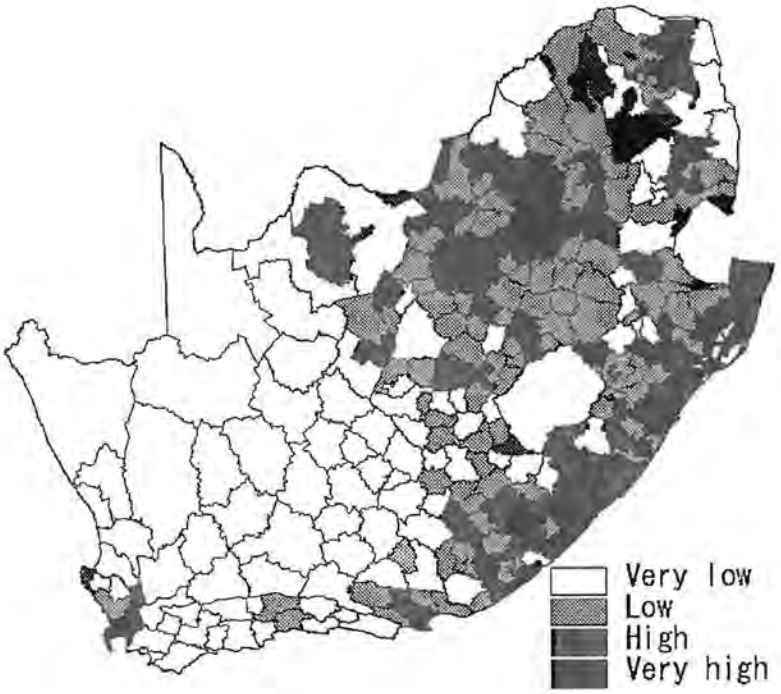

Figure 2. Representation of the negative social sustainable development indicators for South African magisterial districts

3.1.2 Positive indicators

The data indicate a positive correlation between most positive social sustainable development variables. Negative correlation is identifiable between households with access to pit-latrine facilities and the percentage functional literacy, households with access to full service and on-site water facilities, households with piped water and those with access to bucket latrine facilities. A negative correlation appears between community services and households with access to on-site water facilities and those with access to pit-latrine facilities (Table 1).

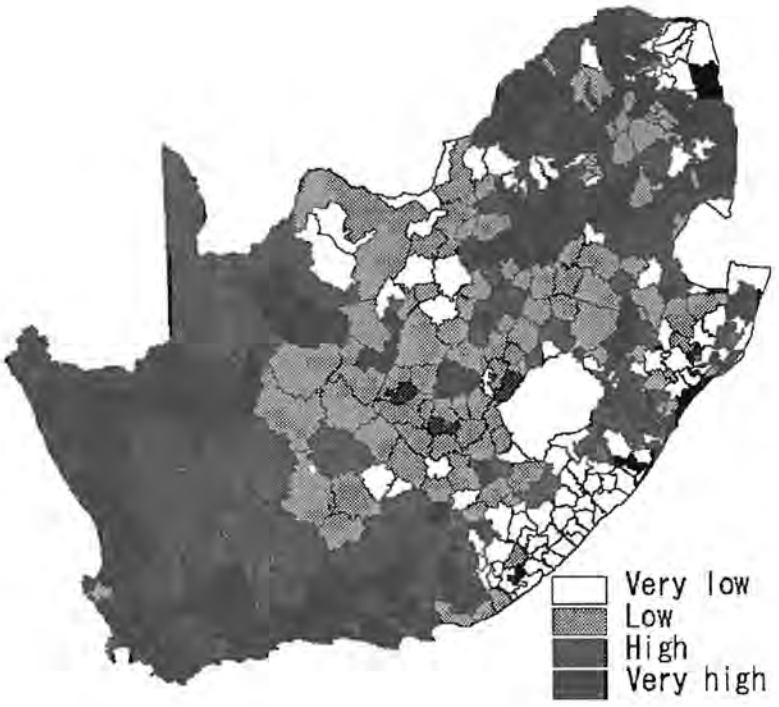

Figure 3. Representation of the positive social sustainable development indicators for South African magisterial districts

Figure 3 shows the results of the data of positive social sustainable development indicators. Districts that are indicated by very high positive values represent the South African magisterial districts with the greatest percentage of households that have access to water and latrine facilities, highest percentage of functional literacy and districts that have adequate access to community services. Figure 4 indicates the relationship between the positive social indicators and indices of social sustainable development. The results indicate the absence ($r^2 = 0.005$, $P = < 0.001$, $n = 373$) of a co-variation between the data sets of the positive indicators and social sustainable development index.

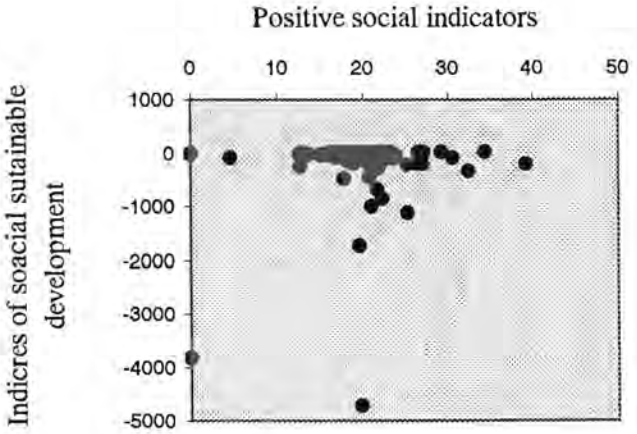

Figure 4. Correlation between the positive social indicators and indices of social sustainable development

3.1.3 Negative and positive indicators

Most positive social sustainable development variables appear to be negatively correlated with the negative social sustainable development variables. Urban-rural spread indicates a positive correlation with the percentage functional literacy, households with access to full services, piped water and the community services. Households with access to pit-latrine facilities appear to be positively correlated with households with no access to piped water and those with access to off-site water facilities, population growth rate and unemployment rate. Households with access to bucket latrine facilities were positively correlated with the population density (Table 1).

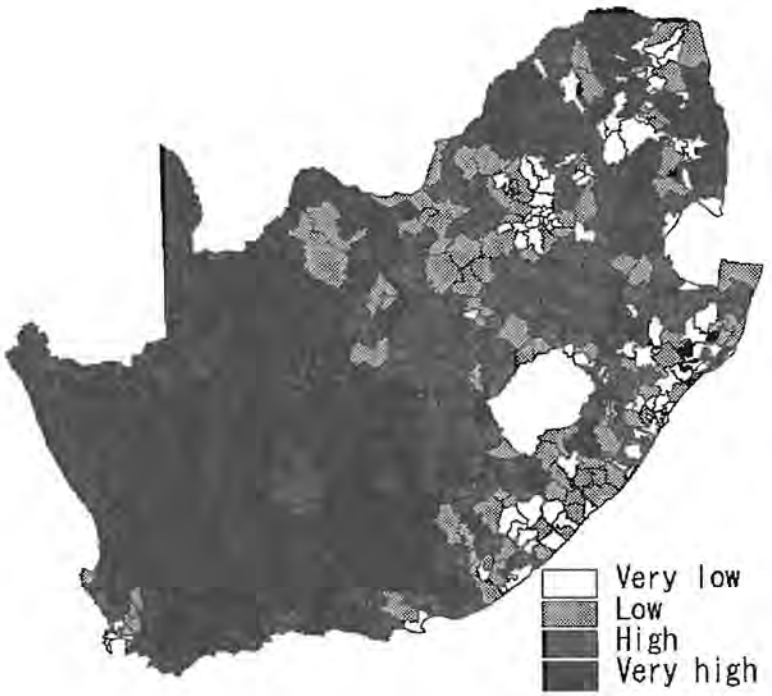

Figure 5. Representation of the social sustainable development indices for South African magisterial districts

Figure 5 shows the results of the data of indices derived from the differences between the positive and negative social sustainable development indicators. As indicated on the legend, the variation pattern ranges from districts indicating very low indices to those indicating very high indices. Districts that are indicated by a very high index represent South African magisterial districts that show a better progress towards social sustainable development and those indicated by very low index indicate a poor state.

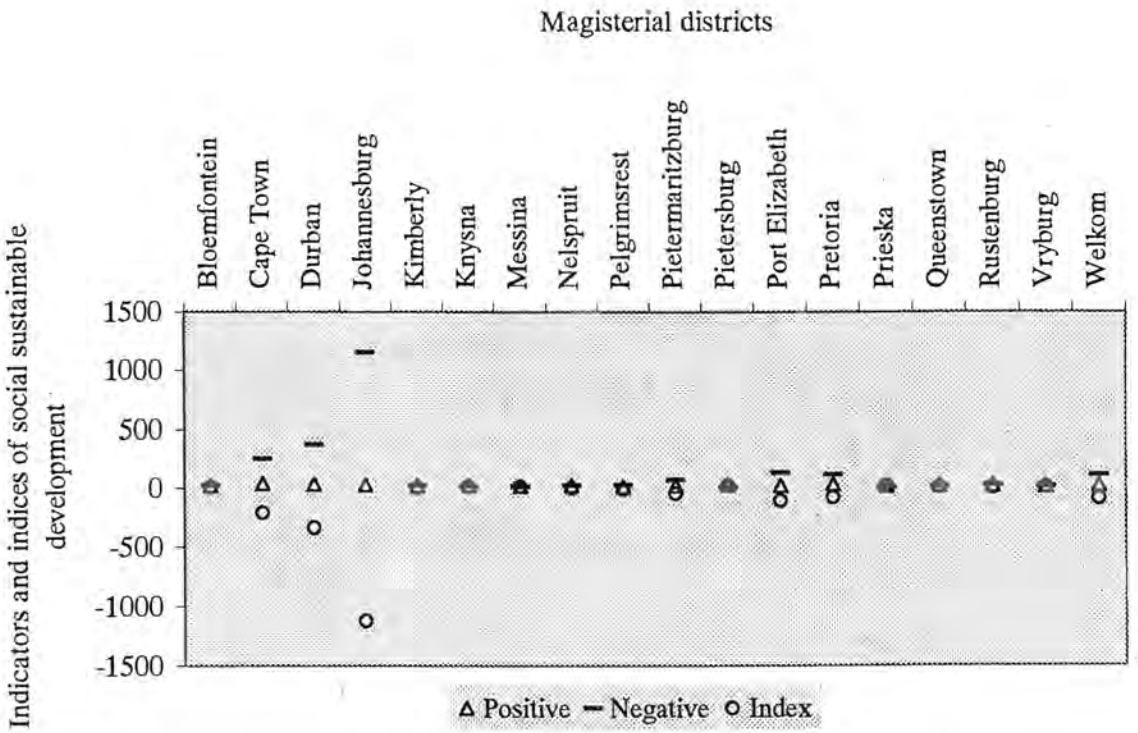

Figure 6. Diagram illustrating the co-variation between negative and positive indicators, and indices of social sustainable development for South African magisterial districts

Figure 6 illustrates the co-variation pattern between the negative and positive social indicators, and the key trends determining the driving forces in social sustainable development. The results indicate that districts characterized by very high negative

indicators tend to show very low indices (see, Table 2). For example Johannesburg and Durban indicate very high negative indicators as a consequence they show very low social sustainable development indices. However Knysna, Messina, Pietersburg, Prieska, Queenstown, and Vryburg indicate very low negative indicators as a result they show high social sustainable development indices. It may further be suggested that Pelgrimsrest, Pietermaritzburg, Pretoria and Welkom represent an intermediate state relative to the above-indicated districts.

Table 2. The ranked values, positive and negative social sustainable development indicators and indices of social sustainable development for South African magisterial districts

District Name	Positive	Rank	Negative	Rank	Index	Rank
Bloemfontein	23.20	356	20.44	216	2.77	189
Cape Town	39.19	373	251.86	359	-212.67	16
Durban	32.44	371	374.56	364	-342.13	10
Johannesburg	25.23	361	1150.97	370	-1125.74	4
Kimberly	21.49	327	21.10	222	0.39	162
Knysna	20.92	302	10.76	80	10.16	311
Messina	18.76	196	9.90	61	8.85	299
Nelspruit	22.41	345	20.45	217	1.96	178
Pelgrimsrest	12.85	24	24.92	229	-12.06	141
Pietermaritzburg	23.90	359	72.82	328	-48.92	47
Pietersburg	27.00	366	7.75	33	19.24	371
Port Elizabeth	22.14	342	133.58	346	-111.43	28
Pretoria	30.60	370	114.54	342	-83.94	36
Prieska	18.51	173	4.61	4	13.90	355
Queenstown	20.50	285	12.64	125	7.86	286
Rustenburg	21.26	319	19.77	212	1.49	170
Vryburg	17.81	111	9.98	63	7.83	284
Welkom	20.97	306	111.72	341	-90.75	33

3.2 Economic sustainable development indicators

3.2.1 Negative indicators

As there is only one variable used to indicate negative economic sustainable development, it could not be correlated with other negative variables (see, Appendix 3). Figure 7 indicates the relationship between the negative economic indicators and indices of economic sustainable development. The results indicate a very high significant (r^2 = 0.999, P = < 0.001, n = 373) co-variation between the data of the negative economic indicators and indices of economic sustainable development.

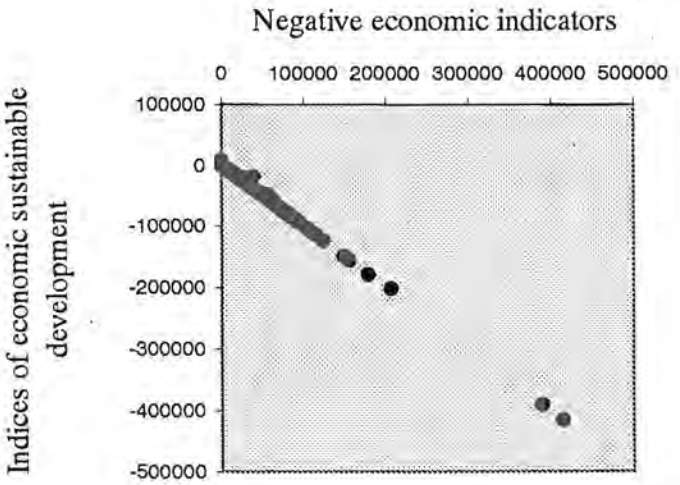

Figure 7. Correlation between the negative economic indicators and indices of economic sustainable development

Figure 8 shows the results of the data of negative economic sustainable development indicators. Districts indicated by very high negative values represent the South

African magisterial districts with the highest poverty gap. Many districts in the Eastern Cape, KwaZulu Natal, Northern Cape and Northern Province show the highest levels of poverty gap. However many districts in the Western Cape, Free State, and Gauteng Province show the lowest levels of poverty gap.

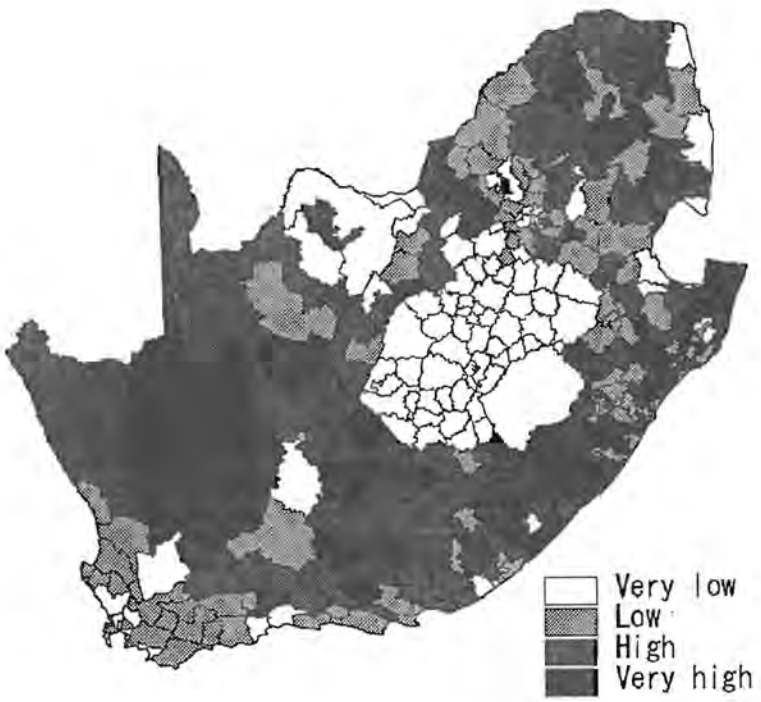

Figure 8. Representation of the negative economic sustainable development indicators for South African magisterial districts

3.2.2 Positive indicators

Positive economic sustainable development variables indicate a very high positive relationship between each other. A positive correlation exists between the potential labor force and the paid employees in the agricultural sector and the gross remuneration of employees. Manufacturing, construction and the income from other producers correlates positively with the paid employees in agricultural sector, trade and catering, finance and real estates. Transport and communication appeared to be positively correlated with potential labor force, paid employees in agricultural sector and the gross remuneration of employees (Table 1).

Figure 9 shows the results of the data of positive economic sustainable development indicators. Districts that are indicated by very high positive values represent the most economically active South African magisterial districts. Whereas those that are indicated by very low positive indicators represent South African magisterial districts with very low economic activities (see, Appendix 3). Many districts in the Eastern Cape, North West and Northern Province and some in KwaZulu Natal and some districts in Gauteng Province appear to be less economically active.

Figure 10 indicates the relationship between the positive economic variables and indices of economic sustainable development. The results indicate the absence ($r^2 = 0$, $P = < 0.001$, $n = 373$) of a co-variation between the data sets of positive economic indicators with economic sustainable development indices.

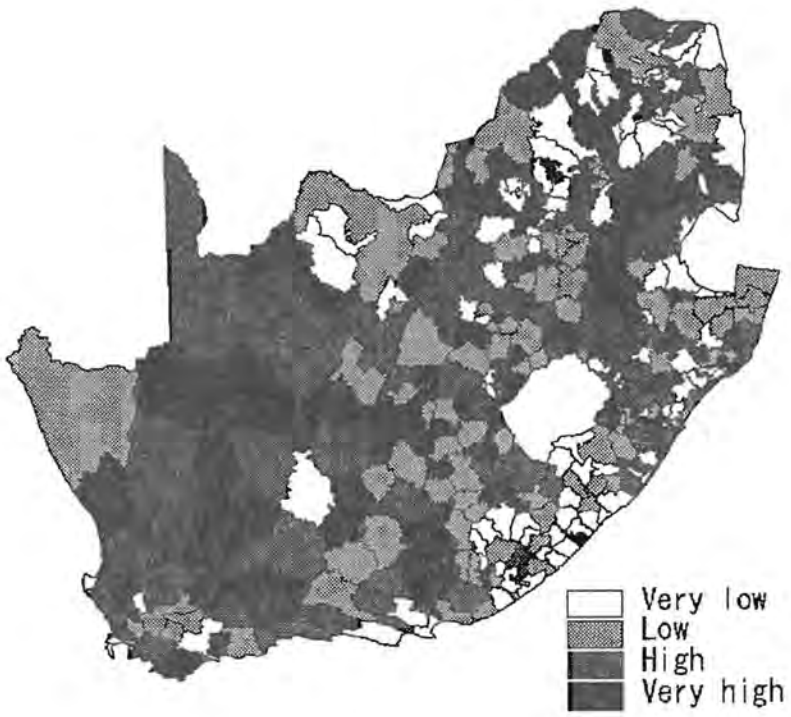

Figure 9. Representation of the positive economic sustainable development indicators for South African magisterial districts

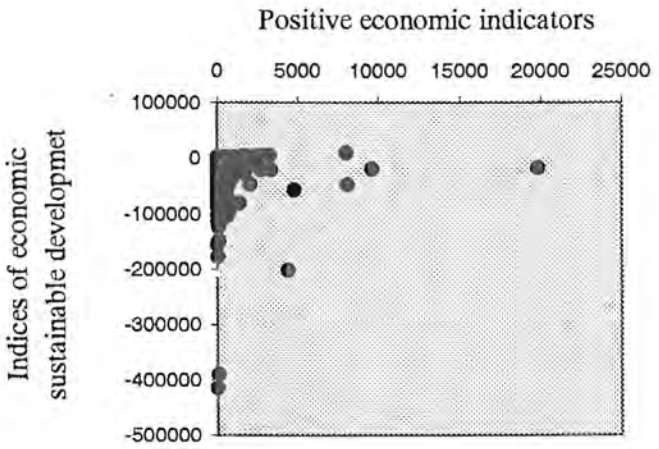

Figure 10. Correlation between the positive economic variables and indices of economic sustainable development

3.2.3 Negative and positive indicators

The data indicates a very low correlation between negative and positive social sustainable development variables. Figure 11 shows the results of the indices derived from the difference between the positive and negative economic sustainable development indicators. As indicated on the legend, the variation pattern ranges from districts indicating very low indices to those indicating very high indices. Districts that are indicated by very high indices represent South African magisterial districts that show a better progress towards economic sustainable development and those that are indicated by very low index indicate a poor economic state (Table 1).

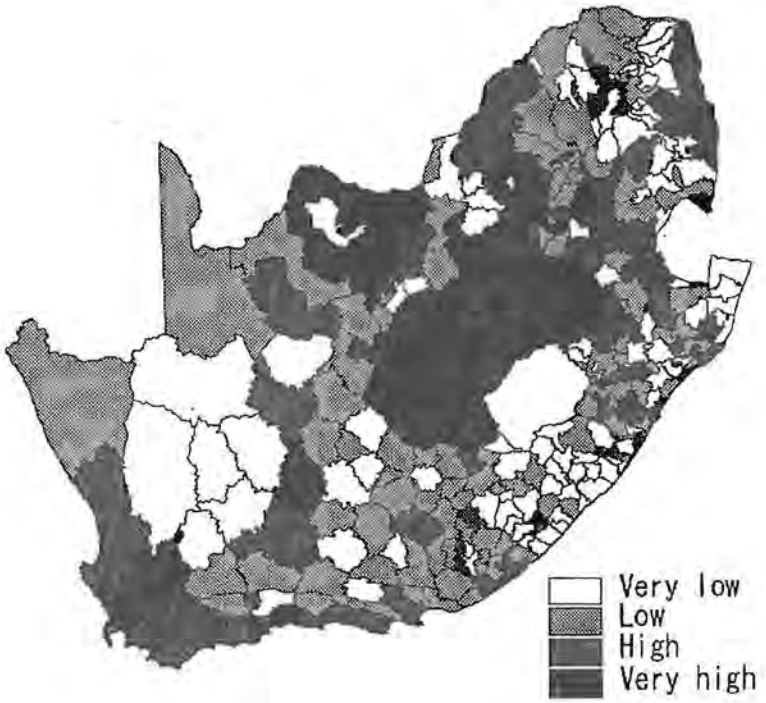

Figure 11. Representation of the economic sustainable development indices for South African magisterial districts

Figure 12 illustrates the co-variation pattern between the negative and positive economic sustainable development indicators and the key trends determining the driving forces in economic sustainable development. The results indicate that districts characterized by very high negative indicators tend to indicate very low indices (see, Table 3). For example Nelspruit and Pelgrimsrest indicate very high negative values as a consequence they show very low economic sustainable development indices. However Bloemfontein and Welkom indicate very low negative indicators as a result they show high social sustainable development indices. It may further be suggested that Johannesburg, Knysna and Vryburg represent an intermediate state relative to the above-indicated districts.

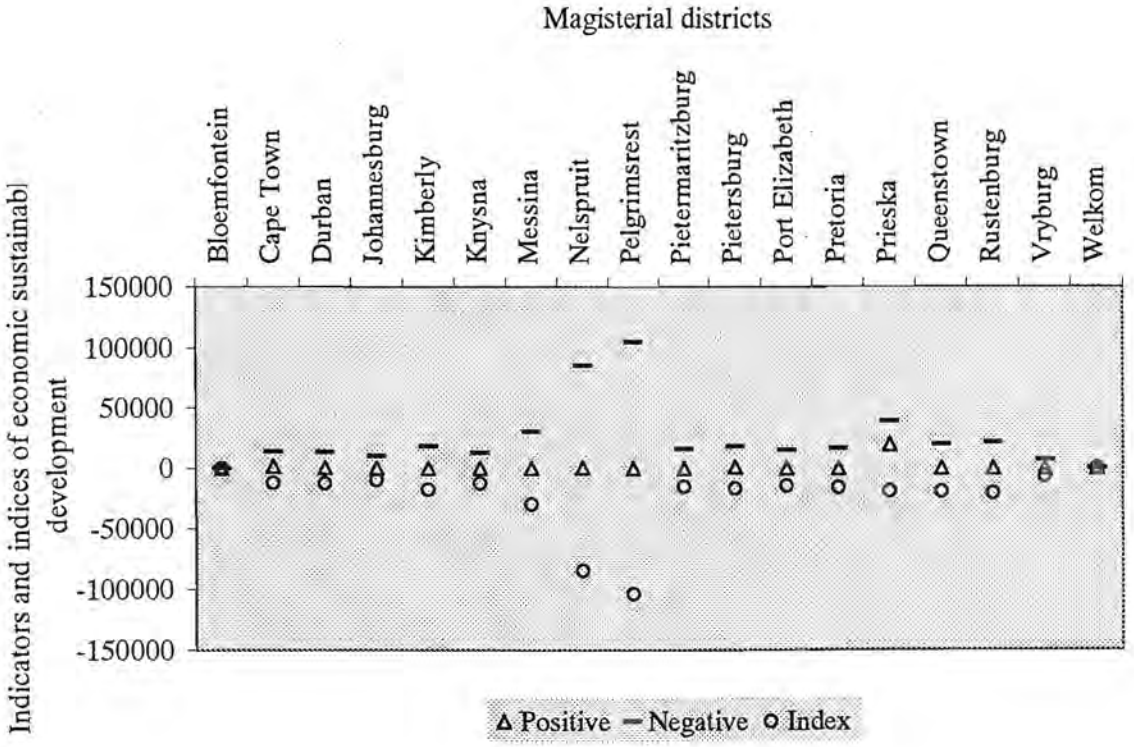

Figure 12. Diagram illustrating the co-variation between negative and positive indicators, and indices of economic sustainable development for South African magisterial districts

Table 3. The ranked values, positive and negative economic sustainable development indicators and indices of economic sustainable development for South African magisterial districts

District Name	Positive	Rank	Negative	Rank	Index	Rank
Bloemfontein	170.72	262	0.08	9	170.64	357
Cape Town	1375.93	355	13818.31	107	-12442.38	276
Durban	579.61	335	13394.03	101	-12814.43	274
Johannesburg	166.53	257	10138.32	82	-9971.79	291
Kimberly	151.55	245	18188.72	143	-18037.17	233
Knysna	113.34	219	13057.80	98	-12944.46	273
Messina	180.99	266	30523.81	228	-30342.82	143
Nelspruit	359.97	318	85041.19	352	-84681.22	22
Pelgrimsrest	67.30	156	104379.89	361	-104312.59	12
Pietermaritzburg	33.81	114	15766.05	117	-15732.24	254
Pietersburg	980.43	348	18170.86	142	-17190.43	241
Port Elizabeth	1.78	8	14840.63	111	-14838.85	262
Pretoria	13.00	63	16777.27	125	-16764.28	247
Prieska	19836.42	373	38948.94	279	-19112.52	225
Queenstown	12.25	61	19574.92	152	-19562.68	219
Rustenburg	5.16	19	21546.46	167	-21541.30	205
Vryburg	26.96	95	6894.93	71	-6867.98	303
Welkom	1.94	9	0.05	8	1.89	317

3.3 Environmental sustainable development indicators

3.3.1 Negative indicators

The data indicates a positive correlation between most variables related to agricultural production: use of fertilizers, energy use in agriculture, electricity, gas and water, income from livestock and field crops, horticulture and income from agriculture, fishing and forestry. The use of agricultural pesticides indicates a positive correlation with the use of fertilizers, income from livestock and the mining intensity index. The use of fertilizers indicates a positive correlation with the intensity of cattle production. Income from horticulture indicates a positive correlation with mining and quarrying (Table 1).

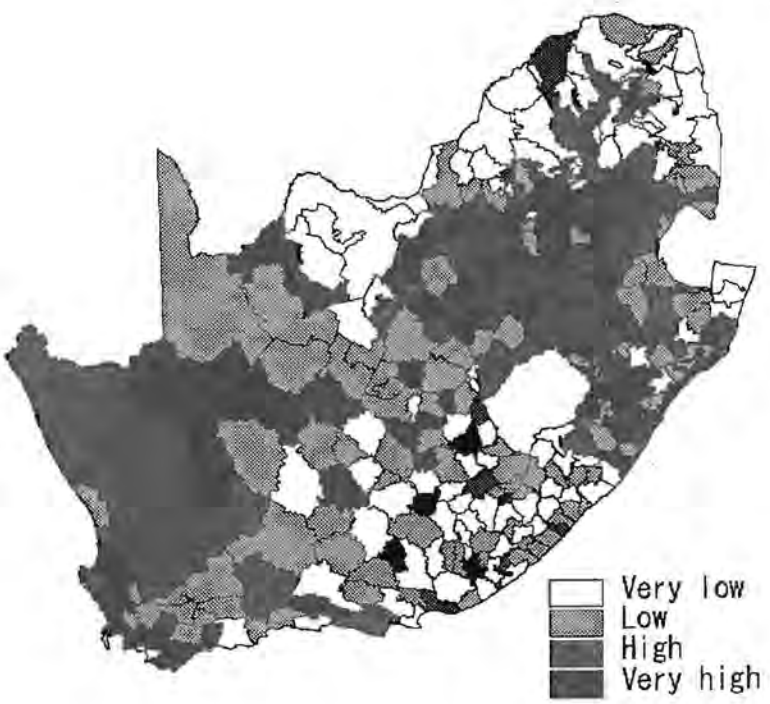

Figure 13. Representation of the negative environmental sustainable development indicators for South African magisterial districts

Figure 13 shows the results of the data of negative environmental sustainable development indicators. Districts indicated by very high negative values represent South African magisterial districts that uses the greatest amount of pesticides and fertilizers, those that mine most natural resources and consume most energy, and those with the greatest population growth rate. The data indicates low intensity of agricultural production, mining and energy consumption in many districts of Eastern Cape and Northern Province, and some districts in the North West Province. However districts in KwaZulu Natal and Mpumalanga, and some in Gauteng and Free State Province indicate a high intensity of agricultural production, mining and energy consumption.

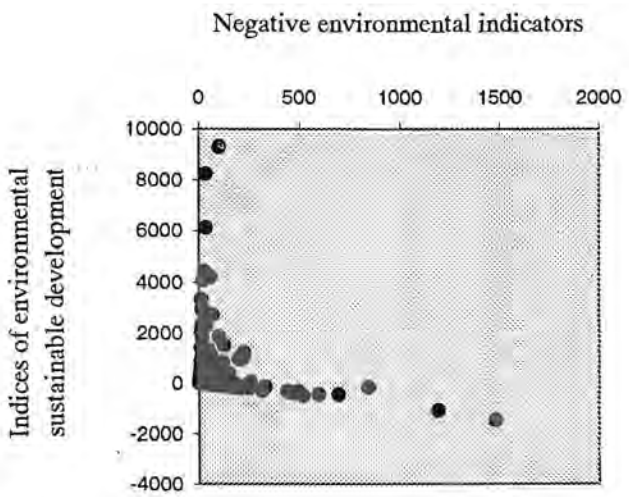

Figure 14. Correlation between the negative environmental indicators and indices of environmental sustainable development

Figure 14 indicates the relationship between the negative environmental indicators and indices of environmental sustainable development. The results indicate a very low significant ($r^2 = 0.028$, $P = < 0.001$, $n = 373$) co-variation between the data sets of the negative environmental indicators with environmental sustainable development index.

3.3.2 Positive indicators

The positive environmental variables indicate a negative correlation between species density and the arable land per capita (Table 1). Figure 15 shows the results of the data of positive environmental sustainable development indicators. Districts that are indicated by very high positive values represent South African magisterial districts with the largest arable land per capita, protected areas and highest species density. In the Eastern Cape, KwaZulu Natal, Gauteng and the Northern Province many districts appear to have low positive environmental sustainable development indicators.

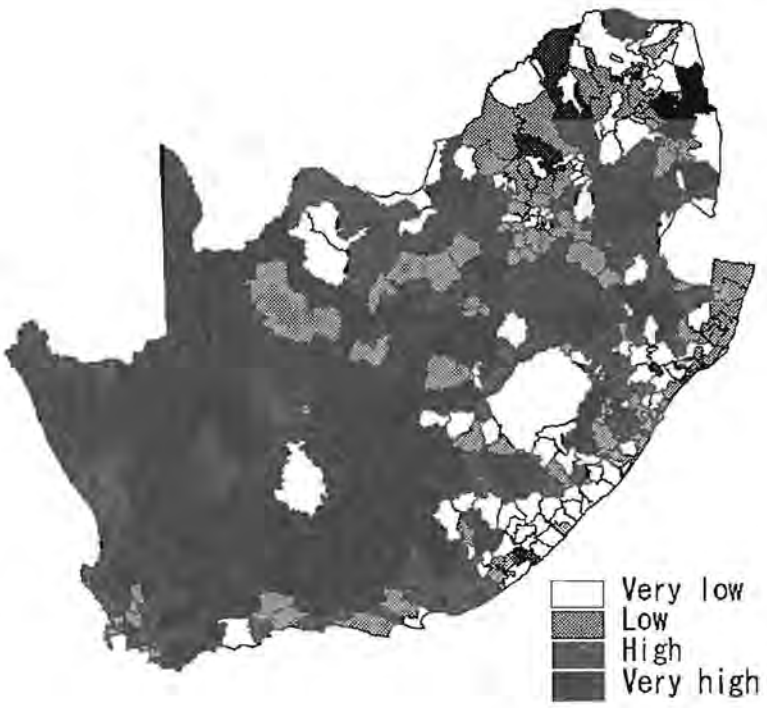

Figure 15. Representation of the positive environmental sustainable development indicators for South African magisterial districts

Figure 16 indicates the relationship between the positive environmental indicators and indices of environmental sustainable development. The results indicate a very high significant (r^2 = 0.978, P = < 0.001, n = 373) co-variation between the data sets of positive environmental indicators with environmental sustainable development index.

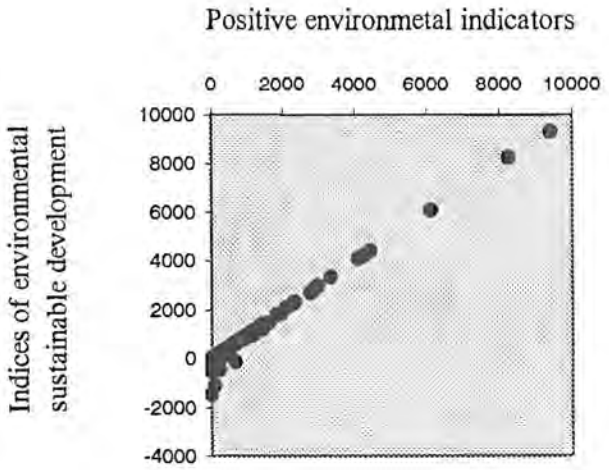

Figure 16. Correlation between the positive environmental indicators and indices of environmental sustainable development

3.3.3 Negative and positive indicators

Arable land per capita indicates a positive correlation with the energy use in agriculture, income from livestock, field crops, agriculture, fishing and forestry. Species density indicates a positive correlation with the intensity of cattle production and the intensity of maize production. Species density indicates a negative correlation with agriculture, fishing and forestry. A negative correlation appears between the arable land per capita and the use of agricultural pesticides, fertilizers, intensity of cattle production and the population growth rate.

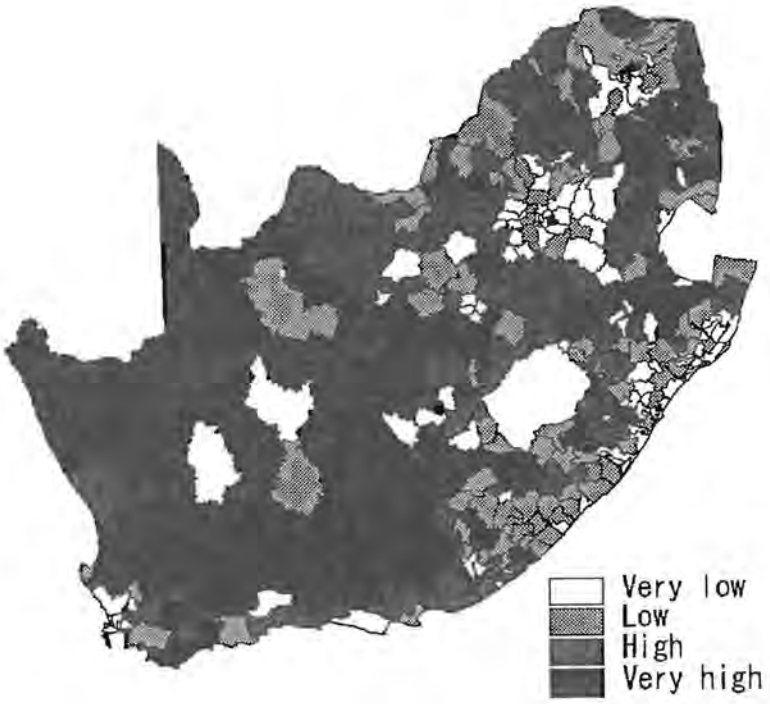

Figure 17. Representation of the environmental sustainable development indices for South African magisterial districts

Figure 18 illustrates the co-variation between negative and positive indicators, and indices of environmental sustainable development for South African magisterial districts. The results indicate that districts characterized by low negative indicators tend to indicate high environmental sustainable development indices (see, Table 4). For example Messina and Queenstown indicate very low negative indicators as a consequence they show very high environmental sustainable development indices. However Prieska indicates very high negative indicator as a result it shows a low environmental sustainable development index. It may be suggested that Bloemfontein, Pelgrimsrest and Pretoria represent an intermediate state relative to the above-indicated districts.

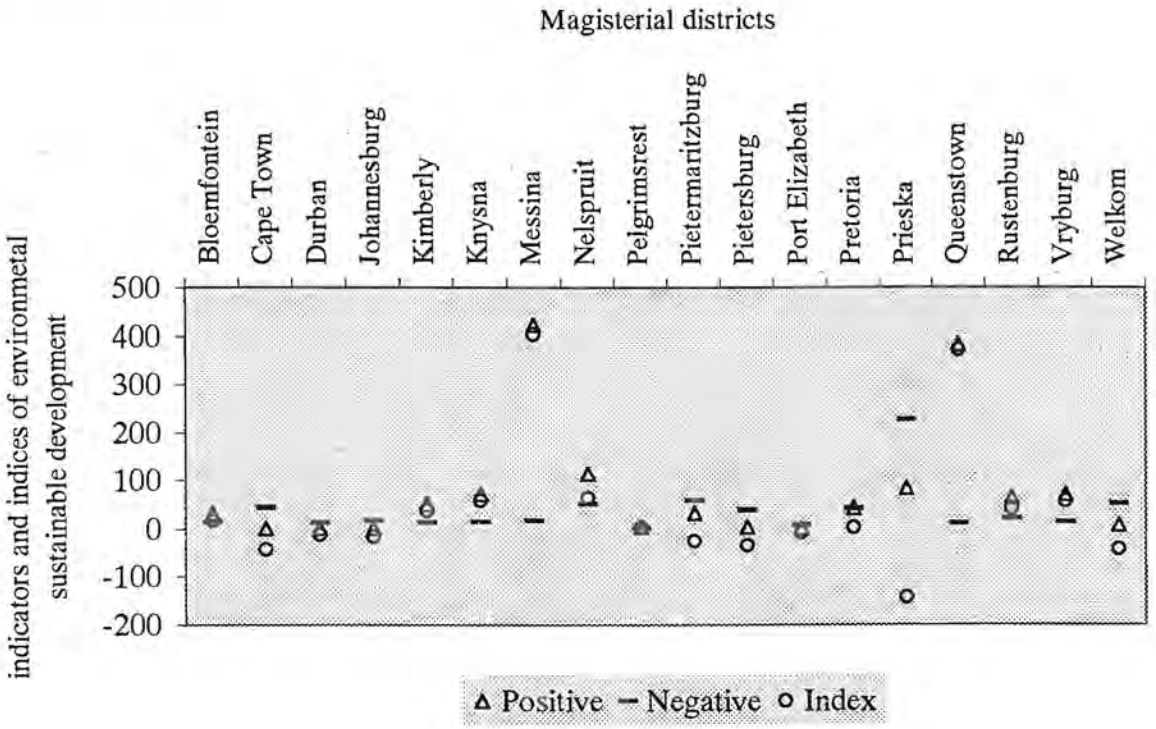

Figure 18. Diagram illustrating the co-variation between negative and positive indicators, and indices of environmental sustainable development for South African magisterial districts

Table 4. The ranked values, positive and negative environmental sustainable development indicators and indices of environmental sustainable development for South African magisterial districts

District Name	Positive	Rank	Negative	Rank	Index	Rank
Bloemfontein	31.33	160	14.14	93	17.19	207
Cape Town	1.23	97	43.74	222	-42.52	65
Durban	0.82	79	12.73	80	-11.92	124
Johannesburg	0.75	72	16.65	111	-15.90	111
Kimberly	50.98	181	13.61	88	37.37	224
Knysna	71.45	201	14.35	95	57.10	236
Messina	421.76	320	17.66	116	404.10	324
Nelspruit	113.69	239	51.25	241	62.44	239
Pelgrimsrest	4.03	119	1.68	14	2.36	188
Pietermaritzburg	32.25	162	58.04	253	-25.79	85
Pietersburg	3.40	117	38.84	206	-35.44	75
Port Elizabeth	0.77	74	8.52	55	-7.75	141
Pretoria	43.12	172	41.06	214	2.06	187
Prieska	83.12	212	226.81	357	-143.69	21
Queenstown	381.58	314	10.47	68	371.12	319
Rustenburg	62.33	194	21.19	138	41.13	226
Vryburg	69.70	199	13.32	86	56.38	235
Welkom	7.62	130	50.83	240	-43.21	64

4. Social and economic sustainable development indicators

4.1 Negative correlation

Population growth rate indicates a negative correlation with the potential labor force and the gross remuneration of employees. Paid employees in agricultural sector indicate a negative correlation with access to pit latrine facilities, off-site water facilities, population growth rate, population density and the unemployment rate. A negative correlation appears between poverty gap and the percentage functional literacy, households with access to full services, access to piped water, on-site water facilities and those with access to bucket latrine facilities (Table 1).

4.2 Positive correlation

A positive relationship is identifiable between the paid employees in agricultural sector and the households with access to full services, on-site water facilities, piped water and those with access to septic tank latrine facilities. Income from manufacturing indicates a positive correlation with households with access to piped water and those with access to septic tank latrine facilities. Transport and communication appear to be positively correlated with the households with access to full services. Households with access to septic tank water facilities show a positive correlation with the potential labor force and construction. Poverty gap indicates a positive correlation with access to pit latrine facilities, off site water facilities and households with no access to piped water and the unemployment rate.

5. Environmental, social and economic sustainable development indicators

5.1 Negative correlation

The negative correlation appears between mining intensity index and households with access to pit and septic-tank latrine facilities, those with no access to piped water, access to off-site water facilities, unemployment rate and the income from agriculture, fishing and forestry. Mining and quarrying indicates a negative correlation with the unemployment rate. Income from livestock, agriculture, fishing and forestry and energy use in agriculture are negatively correlated with access to pit latrine facilities, population growth rate, and households with access to off-site water facilities and unemployment rate. The energy use in agriculture indicates a negative correlation with households with no access to piped water.

Use of agricultural pesticides and fertilizers indicate a negative correlation with households with no access to pit-latrine facilities, piped water facilities, off-site water facilities, unemployment rate and the poverty gap. Income from field crops and horticulture indicate a negative correlation with the population growth rate and unemployment rate. Income from horticulture appears to be negatively correlated with households with access to off-site water facilities. Population growth rate indicates a negative correlation with households with access to full services, on-site water facilities and septic tank latrine facilities.

5.2 Positive correlation

There appears to be a positive relationship between the percentage functional literacy, households with access to full services and the use of agricultural pesticides, fertilizers and the mining intensity index. Mining and quarrying indicates a positive correlation with the potential labor force and gross remuneration of employees. The use of agricultural pesticides and the mining intensity index are positively correlated with the access to bucket latrine facilities and the community services. The positive correlation is identifiable between the use of fertilizers and access to on-site water facilities, septic tank latrine facilities and paid employees in agricultural sector. Income from field crops is positively correlated with access to bucket latrine facilities, paid employees in agricultural sector and manufacturing.

Intensity of cattle production correlates positively with access to pit-latrine facilities, off-site water facilities and household with no access to piped water and the population growth rate. The arable land per capita and the energy use in agriculture indicate a positive correlation with paid employees in agricultural sector, households with access to full services, on-site water facilities, piped water and the septic tank latrine facilities. A positive relationship appears between the income from agriculture, fishing and forestry with the households that have access to piped water, potential labor force, paid employees in agricultural sector and gross remuneration of employees, general government, manufacturing and construction and income earned by other producers.

Energy use in agriculture indicates a positive correlation with the potential labor force and the manufacturing. The urban rural spread indicates a positive correlation with the mining intensity index. Species density indicates a positive correlation with the households with access to bucket latrine facilities, population growth rate and population density. A positive correlation is identifiable between the poverty gap and the consumption of electricity, gas and water. Protected areas indicate a positive correlation with the population growth rate and poverty gap.

6. Discussion

Literacy

The notion advocating education as a potential investment has been widely expressed. It is stated that poverty resulting from the failure to invest in education and to provide people with the basic necessities of livelihood is as much a kind of debt as a financial one (The Economist, 1999 and Dahl, 1997). The results of the present study suggest that South African districts characterized by low percentage functional literacy tend to indicate a high poverty gap.

It has been categorically expressed (Dahl, 1997) that people require education and training to develop their potential to become productive members of the society. The present study shows that South African districts with high percentage functional literacy tend to have many households with access to latrine and water facilities. However districts indicated above tend to have less households with access to pit latrine facilities. These results may be explained by Becker's (1998) statement, that "education assists in furthering knowledge of sustainable development and in improving quality of life through such means as knowledge of hygiene, nutrition, job training and communication."

Population growth rate

Sustainable development in developing countries means controlling population growth, eliminating poverty, and increasing the capacity of rural peoples to influence

and control their future (Upreti, 1994). In evaluating attitudes towards population growth and the environment, Holl *et al.* (1993) observed that fewer Costa Rica students compared to USA students acknowledged the human population growth/environment quality link. In addition more Costa Rica students perceived the need for population growth to support the economy. The present study indicates that districts characterized by a high population growth rate appear to have high population densities and high unemployment rate. The identified positive association between the potential labour force and paid employees in the agricultural sector may suggest a largely agrarian economy.

This study shows a negative association between population growth rate and most variables related to agricultural production. Further, it appears that districts characterized by high population growth rate have many households with poor access to water facilities. These trends may further be contrasted with the indicated positive association between an increasing urban-rural spread with the percentage functional literacy, access to latrine and water services, community services, population density and the mining intensity index. Based on there results it may be suggested that urban areas are characterized by better access to water and latrine facilities, more functional literate persons and high population densities.

Urban-rural spread

The South African Resource Conservation and Quality Control (1999) reported that about 16 million South Africans live in poverty. It also indicated that about 72 % of poor people live in rural areas, and that about 70 % of the rural people are poor. The

present study indicates a negative association between the population growth rate with the gross remuneration of employees and the paid employees in the agricultural sector. These results may suggest that areas with high population growth rate have a low number of employees in the agricultural sector and generally reward low remuneration to employees.

Referring to the rural exodus to squatter settlements of the burgeoning cities and the increasing incidence of disease, Moffat (1994) considers such condition to be part of the spiral of unsustainable development that is affecting over 80% of humanity and much of the world's land resources. This concern is relevant to the results of the present study, where districts characterized by high poverty gap appear to have many households with poor access to water and latrine facilities. In addition, districts characterized by high poverty gap indicate high unemployment rate, access to pit latrine facilities and poor access to water facilities.

Arable land per capita

The present study indicates a positive association between arable land per capita and the variables related to agricultural production. Further shows a positive relationship between arable land per capita and variables associated with desirable socio-economic conditions; paid employees in the agricultural sector, households with access to full services, piped water, on-site water facilities, and those with access to septic tank latrine facilities. These results may suggest a positive social development resulting from employment opportunities provided by the agricultural sector and the income earned from agricultural products and services.

It has been indicated (Ebohon, 1996) that in African agriculture the environmentally polluting chemicals and fertilizers are sparingly used, because of cost. The World Bank (1994) indicated that Africa's share in total global fertilizer consumption remains negligible. The present study also shows that South African districts characterized by high poverty gap and high unemployment rate tend to be associated with low amounts of pesticides and fertilizer application. In addition districts with large arable land per capita appear to be associated with low amounts of fertilizer and pesticide application and low intensity of cattle production. Ebohon (1996) associates the use of chemicals and fertilizers exclusively with the cash crop sector.

Species density

Pringle *et al.* (1994) indicates the inadequacy of Western Australia's current network of reserved lands to represent many ecosystems. The authors state that the existing reserves have not been planned on the basis of extensive biological survey. The present study shows a negative association between species density and the arable land per capita, income from agriculture, fishing and forestry. The results also indicate that districts with high species density tend to have many households with access to bucket latrine facilities, high population growth rate and high population density.

Pastoralism has been identified as a threat to biological diversity of some ecosystems (Curry *et al.*, 1994). In the present study districts characterized by high intensity of cattle production tend to be associated with high amounts of fertilizer application. However districts indicating high species density appear to have high intensity of cattle and maize production.

Protected areas

Emphasizing the necessity for the human self-interest in the protection of the natural systems, upon whose services human society depends, Cairns, Jr., (1998) indicated that humans couldn't kill every species on the planet without killing themselves. Even then, Nepal (1997) expresses the contribution of the establishment of protected areas in increasingly marginalizing the livelihood needs of local communities. In the present study districts with large protected areas appear to have high population growth rate and high poverty gap. Hence the integration of community development in conservation poses a great challenge for the management of protected areas.

Becker (1998) warns that the protection of parks resources would not serve the global interests if the local communities were so deprived that they must infringe on protected resource or requires outside support. Owing to the rapid increase in wildlife and nature-based tourism in South Africa, stakeholders have seen protected area tourism as a significant source of revenue while local communities view it as an opportunity to improve their livelihood. Despite the use of guards and other exclusionary measures, people will take what they need from the protected areas for survival if the minimum resources are not available to them (Berkmuller, 1990).

It is argued (Nepal, 1997) that with tourism becoming a principal activity at the local level, and one that does not encourage other productive activities linked to the local resource base, local communities will have the tendency to rely more on tourism. As a consequence local communities become increasingly vulnerable to sudden local and national fluctuations in the tourism market. At the village level and household level, a

large mass of people become even more dependent on the few, but powerful, elite groups who have a bigger share in the local tourism business.

Goodland *et al.* (1990) suggest that the employment opportunities for members of the local communities help sustainability by reducing pressures on local resource use. However Becker (1998) considers the quality of jobs provided by protected areas to be an essential function to improving rural economic well being. Nepal (1997) reported that local people are often left with petty-trading and menial jobs, with a limited scale and impact. Therefore the linkages between economic benefits and protected areas and environmental protection should be clearly visible.

Transport and communication

The implication of advanced telecommunication development to present opportunities for teleworking and rural revival is of importance (Gibbs, 1994). This study shows that districts with more transport and communication services tend to have many households with access to full services, potential labour force, paid employees in the agricultural sector and the gross remuneration of employees. These results may suggest a positive indication about the transport and communication sector's ability to absorb labour and thus lead to an improvement in socio-economic conditions.

Mining

This study shows an association between low unemployment rate and districts characterized by mining and quarrying activities. In addition such districts appear to

have high labour force and indicate high gross remuneration for employees. South African magisterial districts with mining and quarrying show a low percentage of households with poor latrine and water facilities. On the other hand the mining intensity index shows a positive association with desirable social conditions such as the high percentage of functional literacy, access to water and latrine water facilities. It may be suggested that districts with mining and quarrying provide employment opportunities and are associated with better socio-economic conditions.

7. Conclusion

The Hague Development Cooperation Information Department (1997) indicates that in many countries non-sustainable activities are often a result of poverty and a lack of resources or organization. At the 1999 International Forum titled "The Future for the Youth, Humanity and the Earth", by the Nomura Center for Lifelong Integrated Education in Japan, the participants concluded that until poverty is alleviated, sustainable development shall never be attained.

The fact that all development takes place at a certain spot on earth makes development one hundred percent spatial and territorial (Langaas, 1997). On the overall indices of social sustainability indicate a poor state of social sustainable development in many South African magisterial districts in the Eastern Cape, KwaZulu Natal, Gauteng and Northern Province. It can be concluded that the progress towards social sustainable development has been slow in many districts of the above-indicated South African provinces.

The overall pattern of indices of economic sustainable development shows many economically active districts in Western Cape, Free State and Gauteng Province. However many districts in the Eastern Cape, KwaZulu Natal, Northern Province, Northern Cape and some districts in Mpumalanga Province indicate low economic activity. Many South African magisterial districts show a pattern of high environmental sustainability, but districts in Eastern Cape, KwaZulu Natal, Gauteng and some in Mpumalanga and Northern Province indicate a poor state of environmental sustainability.

Indicators are alerting the local governments to priority issues and guiding policy formulations in order to redress the poor state of socio-economic and environmental sustainable development. Goodland and Daly (1993) state that poverty alleviation reduces the need for welfare, transfer of resources and subsidies, thereby eventually lightening demands on governmental budgets. This study shows that in many districts of Eastern Cape, KwaZulu Natal and Northern Province an immediate action is required to redirect the state of development. When a majority of people remain in economic deprivation, illiteracy, and the need to struggle desperately to meet their physiological needs, they cannot effectively deliver their judgement freely as to what constitutes their interest and right (Upreti, 1994).

Policy measures to make available the minimum health care facilities, drinking water, educational and employment opportunities in urban and rural areas of South Africa are required in order to move towards sustainable development. In Japan, for example, the improved education and the overall rise in income levels have brought low rates in population growth. Community development projects related to health and sanitation, education and training, job creation and environmental protection from tourism can contribute towards sustainable development. Further Nepal (1997) stresses the need to balance protected area tourism and conservation while at the same time bringing positive changes to local livelihoods.

Despite all the social and economic benefits of the mining and quarrying the sustainability of the ground resources and the long-term impact of the effluent discharged during the mining process are questionable. Moldan (1997) warns that the excessive use of the ecosystem as a pollution sink is likely to undermine the health of

the ecosystems, impose constraints on economic development, and above all jeopardize human health. The levels of chemical and fossil fuel inputs are used as indicators to determine health impacts on employees and the surrounding community (Becker, 1998). Therefore comprehensive study aimed at addressing the above-indicated concerns will be valuable for the evaluation and monitoring of South African sustainable development.

Stressing the need for a continuous monitoring and evaluation of sustainable development, MacGillivray's (1997) questions whether once the prerequisites of sustainable development have been achieved, people go on to live worthwhile lives in the society? The present study reveals the complexity involved in the evaluation of sustainable development and prompts the need for an integrated and multidisciplinary approach to addressing environmental problems and socio-economic challenges. As demonstrated in this study, monitoring and evaluation of sustainable development requires the use of alternative approaches.