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Title: 'Addressing urban disaster risk and resilience through a green lens'

Abstract:

The paper investigates the concept of developing and maintaining sustainable human settlements in the face of climate change, its pressures and effects and it reviews what the 'greening' of the economy and government policies and strategies mean. After questioning whether this sustainability initiative is, in fact, truly aimed at changing the appeals of low income and poor communities or whether it is simply re-iterating the status quo and sustaining inequality in an already divided society, it concludes that vulnerable communities could essentially benefit from the sustainability drive. The paper places emphasis on the implementation of 'green thinking' by investigating the draft Green Strategic Programme (GPS) that has been developed for the Gauteng Province in South Africa. The Programme informs objectives and activities of departments and municipalities, so that all parts of government working on sustainability issues are focused on the same targets. This initiative addresses the concerns that often surrounds the 'silo'-approach towards governmental processes – something that the disaster management centres in the local and provincial sphere are well aware of. The paper discusses the GSP in context of the benefits and the limitations that it poses for addressing urban disaster risk and resilience and provides brief insight into one of the nine sectors of the GSP – that of land use; and provides examples of how the GSP inherently address disaster risk and resilience. Finally it evaluates the findings and recommendations that were made by the GPS in relation to urban disaster risk and resilience.

Keywords:
Green Strategic Programme, sustainable development, climate change, green economy, green growth, urban disaster risk reduction, urban resilience.

1. Introduction

When considering the theme of the 2010-11 ISDR campaign, the need for adaptation to climate change is high on the agenda (ISDR, 2011). However, when unpacking the concept of climate change and what its mitigation entails, it goes further than the theoretic discussion of carbon emission reduction, which to many relates to an industrial 'revolution' where factory emissions are reduced and photovoltaic panels are manufactured. This industrial sector implementation does not interrogate what is needed with regards to changing the operational environment of business and government into stimulating a 'decoupled' economy where resource exploitation does not drive profit and growth. In fact, it supersedes these physical manifestations of climate change mitigation and reduction, and ultimately boils down to a complete re-vamp of the way in which we, the essentially urban species, live and how the urban spatially-based economy functions. It relates to how the pressures of climate change and low carbon economy requirements translate into green growth, green jobs and a green economy. It also reflects on how metabolic processes in particularly urban areas are driven. These metabolic processes, which include for example food production and -consumption patterns, energy flows, waste generation and –disposal behaviours, and the availability, consumption patterns and quality of potable water, is comparable to the metabolic functions in a human body. The processes and the quality of resources that flows through the system determine the health of it. It embodies the vision of the city as a three-dimensional form, with abilities to withstand onslaughts and 'ailments' which may include pollution, climate change and other disasters. In its totality, it reflects on the sustainability and resilience of the urban environment in regards to global changes and local challenges.

In Gauteng's 2009-2014 Medium Term Strategic Framework (MTSF), the province made a commitment to:

> *" ... encourag(e) the sustainable use of energy in the economy and socio economic development; this will include the utilization of clean and renewable resources; and support sectors that create green jobs as a means to mitigate the impact of climate change"* (MTSF, 2009).

This framework also committed the province to "stimulate redistributive economic development to create decent work, sustainable livelihoods and reduce income inequality", by, among others, creating sustainable jobs (albeit focussing on the Community Works Programme and Expanded Public Works Programme

(EPWP)), promoting green industries and focussing on sustainable community and social cohesion, which includes sustainable mobility and food security. These commitments were subsequently engaged with in the Gauteng Employment Growth and Development Strategy (GEGDS). The GEGDS states that the economy must swing towards an "endogenous economic growth trajectory that is based primarily on innovation, green growth and inclusivity. Furthermore, it states that the province:

> *"… will not have an economy that provides decent work and economic opportunities for all, unless it can become... a green, environmentally friendly economy, which capitalises on the… economic value (that is) to be gained by investing in green processes and products, and uses existing resources in a more efficient and sustainable manner, thus reducing the carbon footprint of (the province). Gauteng needs an economy based on green technologies, green jobs, green energy and green production processes that reduce the ever higher input costs stemming from unsustainable resource use"* (GEGDS, 2010).

It is within this context that the paper discusses and analyse some of the strategies and actions which the Gauteng Provincial government has recently embarked on to further respond to the global drive towards sustainability policy and strategy implementation. Its relevance in regards to disaster risk and resilience is that it may transform the basis on which development decisions are founded, thereby inherently reducing the risk and increasing resilience of the urban environment instead of having to respond and react to the effects of natural hazards.

2. What is a 'green lens'?

Terminology such as 'the green economy', 'green growth' and 'green jobs' has recently become entrenched in government documents and ministers' speeches, when dealing with economic growth and alleviation of unemployment. Others refer to it as a 'sustainable trajectory' or 'resilient future'. In disaster management circles it is referred to in relation to critical infrastructure management being more 'green', and some networks are in this context referred to as 'green infrastructure'. As people attach their own meanings to particular terms, it reflects their position in the global geography of sustainability – even the European Union and countries in the global south, such as India, attach entirely different meanings to the term 'green economy'.

Unfortunately the notion is still very much undefined and may mean vastly different things to different individuals, communities and administrative bodies. When defining this 'green lens' through which development, disaster management, societal life and the economy is viewed, one needs to consider the

paradigm in which it has emerged. When sustainability was first termed in the 1970's (McNicoll, 1970) it did not yet account for global changes including the drive towards low carbon emissions. The climate change debate became part of the discussion in the 1980's, and since then it has gained momentum in both societal and governmental circles. When considering paleoclimatology views and geologic temperature records, forcing mechanisms such as ocean variability, thermohaline circulation, earth's orbital variations, solar output, volcanism and plate tectonics point to definite but sometimes unknown factors that influence the trajectory of climate change. There is also clear evidence of human-induced change that adds to these geospatial drivers. Even though the debate whether climate change is human-induced, or simply a long-term global occurrence is on-going, there is no doubt that we are facing an era of change, mitigation and adaptation to a new living environment on the planet.

This requirement has driven developmental choices, and since development is underscored by administrative policies, legal directives and strategies, it has found its way into governing circles in the form of a variety of arrangements. Nationally and in the Gauteng province, documents with titles such as 'National Framework for Sustainable Development', 'Gauteng Integrated Energy Strategy' (GIES) and the 'Gauteng Climate Change and Response Strategy' (GCCRS) (GDARD, 2011) have been commonly accepted as being part of the drive towards greening development and growth. The recently drafted 'Gauteng Green Strategic Programme' (GCRO, 2011a) is one of the target-based documents that attempt to combine the different provincial and local sphere strategies and policies into one coherent entity. Even though it is sometimes incorrectly referred to as a green economy programme, its essence is based on the drive towards changing the developmental trajectory of the province onto a sustainable path by providing guidance towards implementable activities and measurable targets. It considers all sectors of the urban economy, including:

1. Air quality;
2. Climate Change;
3. Energy;
4. Economic Development;
5. Food Security;
6. Land Use;
7. Transport;
8. Water; and
9. Waste and sanitation.

By focussing on the different segments that directs development and growth, it aims to provide a basis onto which the functioning of the urban system and administrative collaborations may be transposed, in order to move the region onto a trajectory of being a sustainable human settlement. The challenge lies in how to communicate to government and the private sector that in order to become a global green economy player, all of these things has to be addressed at the same time as political agendas attempt to get traction for politicians who has masses of unemployed constituents. The answer lies in a set of quite complicated interactions between government and the private sector and individuals as their tax base, and the way in which profits and losses are perceived.

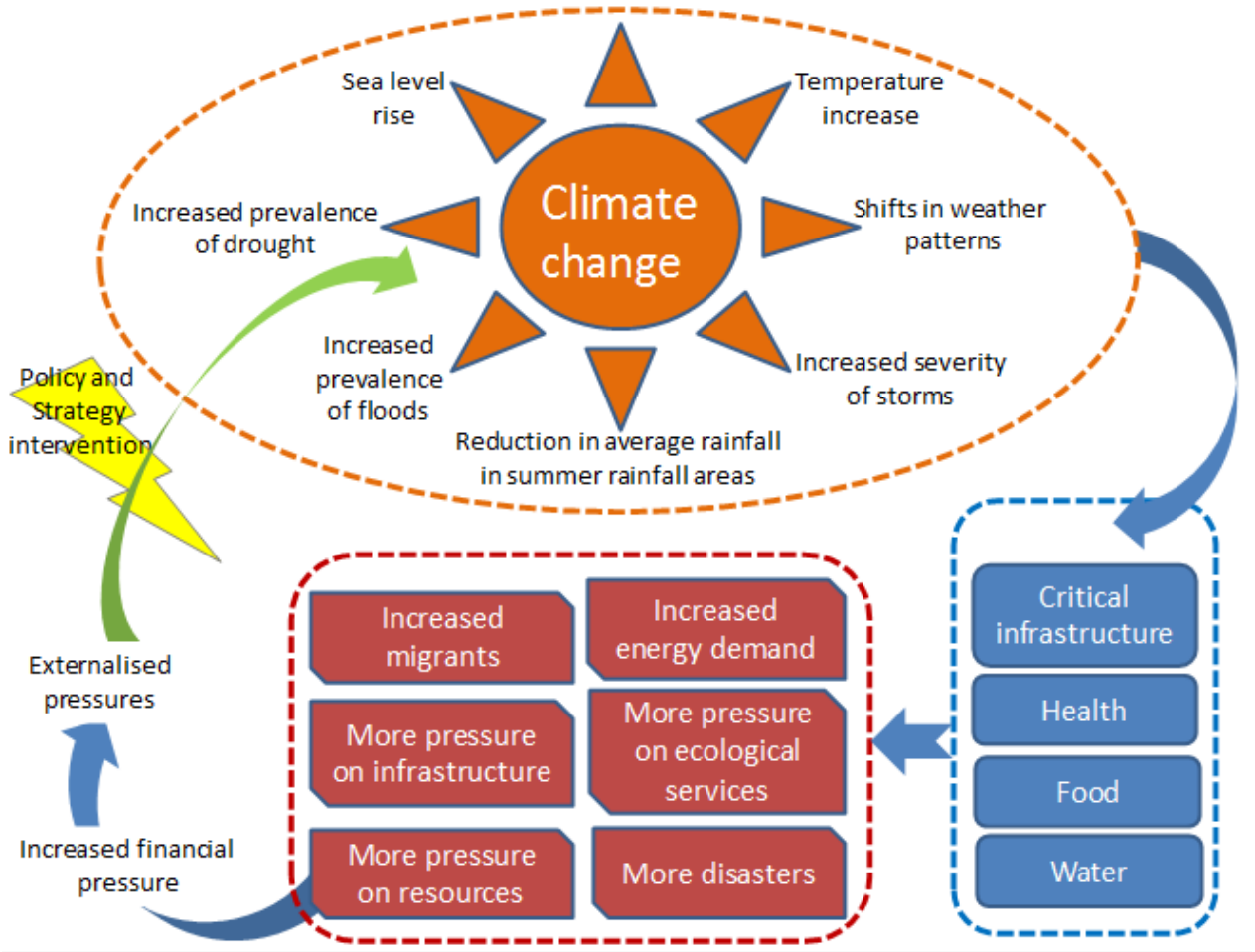
A green strategy and green economic growth is not a sub-section of the traditional economy. It is not a 'sector' or pillar on its own, comparable to agriculture or the energy sector which can be considered sectors of the traditional economy. It is the basis for an entire new type of economy which is being laid. It is an integral part of how society, its economy and its environment functions and it drive the economy as a sustainable instrument. It goes further than pure economics and the need for growth and accumulation of assets. Rather, it relates to utilisation of renewable resources and re-using resources. It is based on creating growth while maintaining the ability of society to live within its means and extract only as much resources as it can replenish within a contained unit of space. It means that the essence of how financial profit is viewed would change into measuring not Rands and cents but rather quality of life and happiness. The 'green lens' is therefore the way in which we view the urban conundrums and options that we are faced with, in the onslaught of climate change, natural hazards and the disasters that are associated with it.

3. The effects of climate change on long term sustainability

When reviewing the predicted effects of climate change in South Africa, the first elements that come to mind is a moderate increase in temperature (especially in the arid parts of the country) (GCCOLP, 2011; Pachauri & Reisinger, 2007) and dramatic shifts in weather patterns. It is predicted that there would be a broad reduction of between 5% and 10% in the average rainfall for the summer rainfall areas (which is where Gauteng is located), with both an increase in the prevalence of drought and floods (GCCOLP, 2011). Sea level rise is also on the agenda, with an almost one metre increase predicted to take place between now and 2100. This will result in secondary effects including human, plant and animal health problems, food scarcity due to reduced agricultural output in the more arid areas of the country, pressure on critical infrastructure (GCRO, 2011) and periodic water scarcities due to the predicted erratic rainfall. This will most likely in turn result in increased flows of migrants seeking opportunities in cities, increased pressure on city infrastructure networks, resources and resource flows, and ecological services, increased demand for

energy (for e.g. to cool urban heat islands and support the growing demand for electricity), and natural hazards that transpire as disasters, damage settlements and livelihoods, and test community resilience. This cycle is depicted in Figure 1.

Figure 1: Diagram depicting the systemic effects of climate change in urban environments



Developed by Storie (2011) for purposes of this paper.

An example of how disasters may arise from natural hazards that intersect human activity is the need to decant more ground water resources and treating it for human consumption or agricultural purposes due to the growing demand for water as well as the impact of droughts. In turn, such decanting may dewater dolomite and limestone aquifers, thereby increasing the prevalence of areas of subsidence and sinkholes in such areas.

All of these effects which are essentially driven by climate change will eventually manifest in an increased pressure on the tax base of regions and countries, and the global economy. Currently, many of these largely unknown costs are externalised, meaning that either another area or geography, and its population, or for that matter future generations, will have to bear the costs and impacts of the development decisions that are made today. One position where intervention is possible to break the cycle is to design policies and strategies which governments can apply to address how and where pressures are directed to. Ideally, the externalised pressures should be internalised into the city and inhabitants of urban areas will need to carry the costs. If development decisions are, however, made in manner that continues resource exploitation, it will result in on-going cause for further climate change effects. In its totality, it depicts a venomous circle of pressures and responses which makes sustainable living a distant dream. Society has to account for these long-term effects and externalised costs in current planning and infrastructure choices, since it locks the urban body into a chosen development and growth path, which not only affects its economy and networks of flow, but the citizens that live in it. In order to work towards an optimum trajectory of sustainability, governments worldwide are addressing their management-behaviour and are creating and implementing strategies and policies that relate to 'greening' their programmes and operations. Part of this includes designing of adaptable infrastructure, as part of infrastructure transitions towards sustainable living.

4. Questioning the beneficiaries of the sustainability initiative

The 'risk reduction angle', which forms the basis of many of the targeted interventions and programmes that drive development, is, apart from addressing government operations, aimed at addressing risk in all levels of society through different types of mediations – both at the high income, middle and low income groups. A few examples of proposed interventions from the draft Gauteng Green Strategic Programme include:

- As part of climate change sector, defining low carbon-driven housing standards and committing to carbon-neutral buildings and infrastructure;
- As part of the land use sector, creating standard alternative methods and technologies for building 'green'; and ensuring community involvement in public housing projects to enable education and awareness raising during the design and implementation of sustainable built environment options;
- As part of energy sector, enforcing policies and regulations that promote the use of renewable energy and energy efficiency, through addressing municipal by-laws relevant to sustainable energy and resource use for how it can support or currently constrain implementation, including for example, building codes;

- Energy sector interventions such as efficiency programmes that include improvement of building efficiency and installation of insulation in ceilings, especially for Reconstruction and Development Plan (RDP) housing; and support of mass roll-out of domestic heat pumps and solar water heaters; and
- As part of the food security sector, the establishment of food gardens at public venues, and community nutrition centres as educational platforms that provide information on good nutrition and alternative foods.

The indirect result of this is hoping to address, apart from the move towards sustainable human settlements, social and economic inequality, which is not only a provincial anxiety but a constant key concern in all of South Africa's urban areas. However, it has been questioned whether the entire sustainability initiative is, in fact, simply aimed at re-iterating the status quo and sustaining inequality in an already divided society. The argument is based on the fact that the appeals of low income and poor communities remain the same, even if sustainability-interventions are made at regional level. For example:

- The cost of alternative infrastructure such as solar water heating remains above the means or desire of low income groups to implement (i.e. it is more important to have food on the table than to install a solar geyser at a once-off cost), thereby locking them into the use of perhaps more affordable, but resource-intensive and carbon-producing coal fired energy.
- Converting residences to make use of the advantages of grey water is desired, but the retrofitting costs are prohibitive when considering the existing design parameters of low cost housing.
- Organic food consumption is mainly available to consumers that have the ability to pay above-average prices for 'fashionable' food.

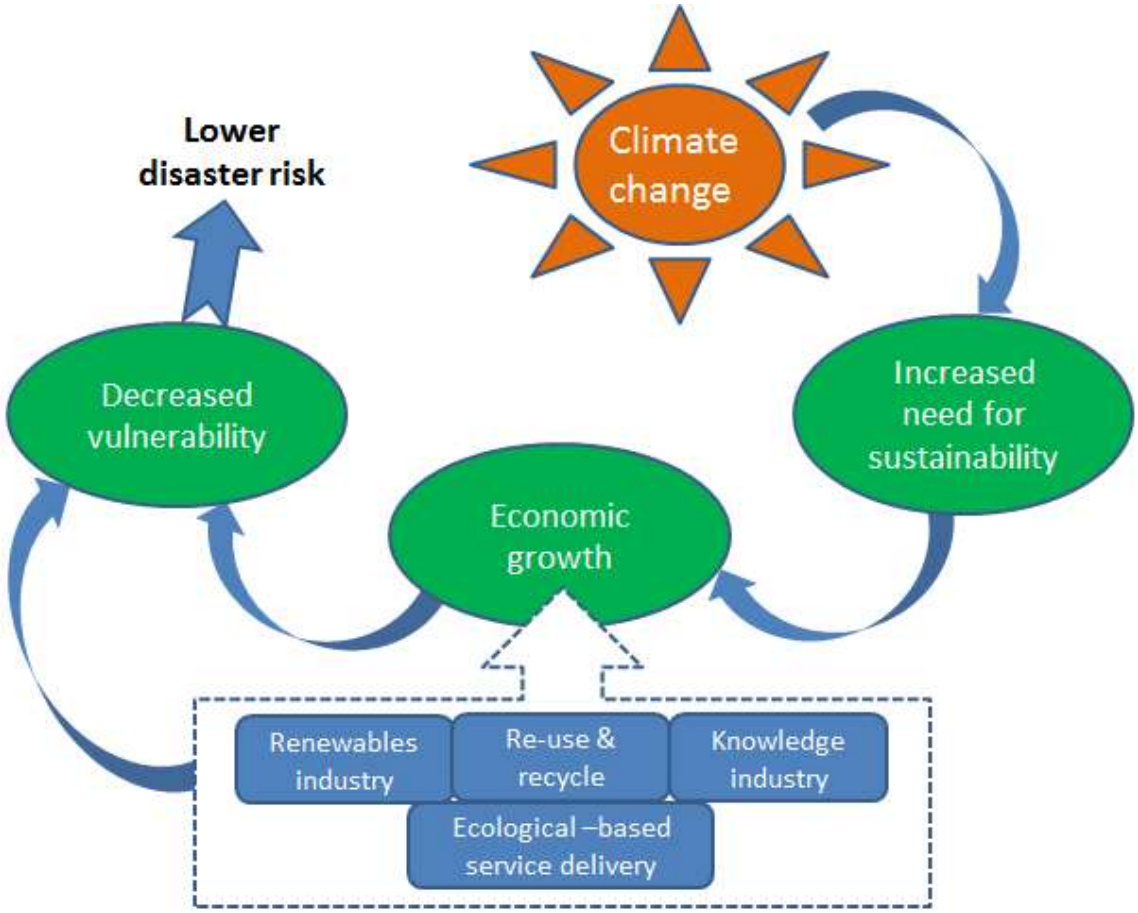
Furthermore, and too often, green jobs are regarded as temporary work packages that focus on elements such as the planting of trees, land-care programmes, waste removal or eradication of invasive alien plants. It is thus pertinent to ask the question as to the reality of sustainability in reducing risk for the whole of society. This prompts some opponents of the sustainability drive to insist that climate change is merely a conspiracy designed to keep developed countries 'ahead' of the rest of the world, and ensure that Africa and countries of the 'global south' remain at their mercy. To some extent, the climate change conspiracy-theory devotees have a point: climate change will in fact deliver an increase in vulnerability for developing countries while the so-called first world continues to advance at a greater pace. At a local scale, through the effects of climate change, the hazards that poor communities face may increase in severity and probability due to their location on marginalised land (such as in flood plains, on erodible soils or on

dolomitic ground), and their vulnerability will increase since they have less resources available to cope with and recover from impacts, thereby enforcing the cycle of low resilience.

In support of the need for affordable development, South Africa's continuous multi-billion rand investments in coal-fired power plants such as Medupi and Kusile comes to mind as one of the energy-sector elements that perpetuates the cycle of vulnerability. One of the unofficial arguments in favour of the coal-fired power plant investments is that it is 'our turn to get cheap energy, so we have every right to use this resource and effect air pollution, just as the developed world has done decades ago'. Even though this is a true reflection of how development took place in the industrial era, it unfortunately does not take into account the negative effects such as respiratory diseases and low quality of life that is associated with living near coal-fired power plants. When considering such arguments further in light of South Africa being in the top ten contributing countries in the world with regards to concentrations of greenhouse gases in the atmosphere caused by human activities, we should be concerned that we may be adding to the tipping point of global climate change. Not only does this reflect a conscious choice and infrastructure lock-in that goes against the principles of climate change mitigation, but we are also fast missing the opportunity to gain economically from the renewable energy drive. Prospects that are passing us by include for example to be the producer or implementor of choice for an Africa that is installing solar panels manufactured in China and Germany (using in many cases South African-mined metals). When considering the magnitude of the impact that it may have had if these panels were instead manufactured in South Africa, it may give an entire new dimension to the term 'green jobs'.

The impacts of climate change and the need for sustainable living should not be viewed separately from strategies and policies that are aimed at economic growth and job creation, since it has the ability to reduce human settlement vulnerability. Figure 2 depicts the cause and effect if development responds to the climate change challenge effectively through elements of green economic growth, thereby lowering disaster risk.

Figure 2: Cyclical cause and effect sustainability and vulnerability



Developed by Storie (2011) for purposes of this paper.

The decoupling of economic growth from resource exploitation is the key to unlocking the potential for South Africa and its industries to become part of the global supply of renewable goods and services. 'Decoupling' in this sense affects the way in which our cities are designed, built and how people live and move in them. It is the human settlement infrastructure, its governing processes and its inhabitants that direct our ability to apply decoupling and risk reduction and ultimately increase the resilience of settlements to disaster risk. No matter what angle we look at it, climate change will essentially affect poorest people more negatively than the wealthy. So even though we are not in line yet for the global drive to benefit environmentally and economically from climate change mitigation programmes, we should focus on policies and strategies that will bring us in line with the aims of climate change mitigation. When this is realised, sustainable human settlements and a 'green economy' would indeed drive urban resilience and lower vulnerability of all communities, including the poor. In this contest, the fundamental challenge is how to move to a green economy and address green job creation without alienating poor communities even further.

5. 'Green lens' decision making in Gauteng

5.1 Background

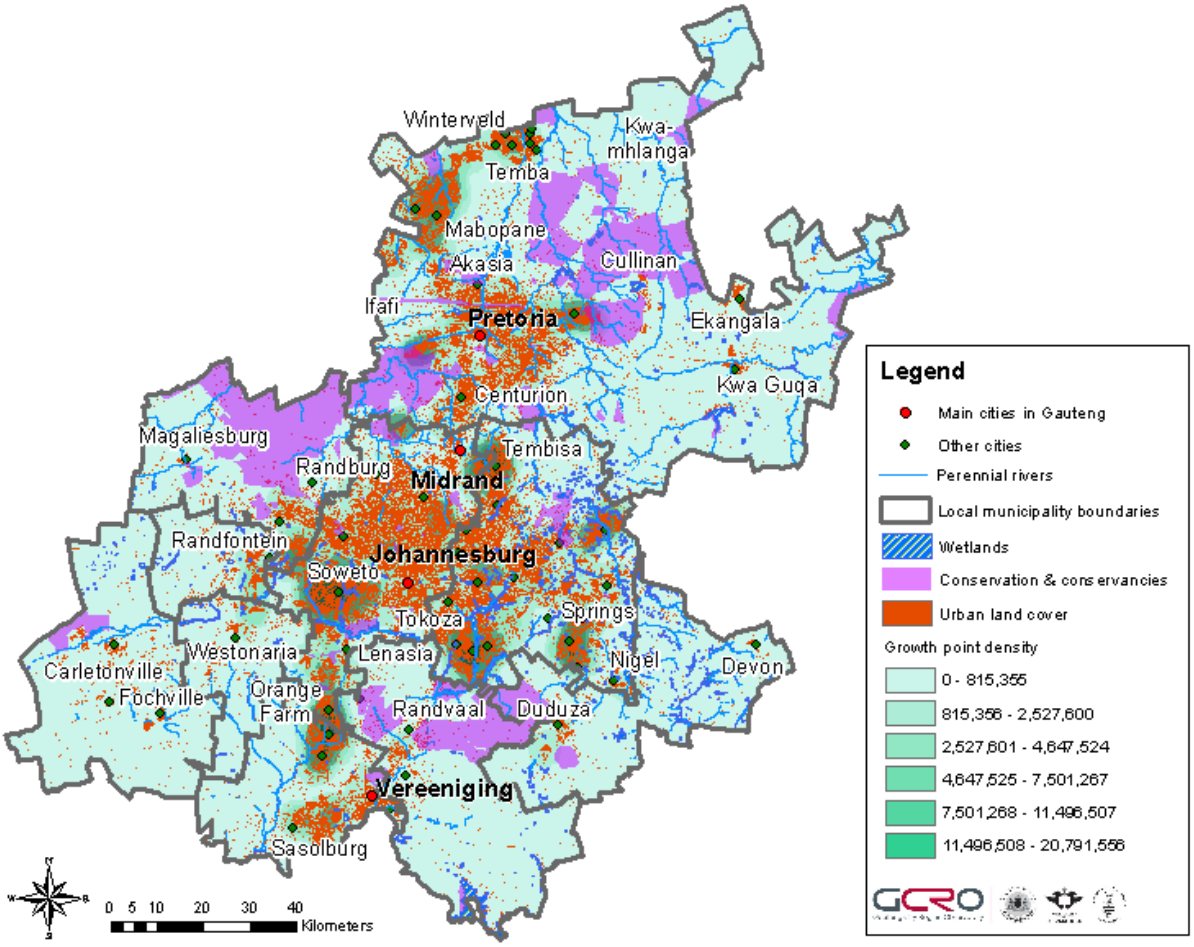
When considering development planning choices which ultimately determine the ability of the urban environment to respond to climate change, one has to consider the fundamental basics of how planning choices are made and the budgeting processes which drive the implementation of projects. One premise that remains in development programme objectives throughout Africa is that better serviced communities will be able to cope with many of the predicted changes which the world face, while poorer communities will be less able to. As part of this proposition, there is a variety of methods in which it is addressed by government, including but not limited to:

- Legislation, regulation, by-laws and guidelines;
- Development of strategies, policies and plans; and
- Implementation of publically and jointly-funded programmes.

Although there are many additional items that may be added to the above list, this paper will focus on these three elements of the development process in Gauteng.

Gauteng is the smallest province in South Africa, covering just over 18 000 square kilometers. However, it houses the most densely populated area in the country with over 11.2 million inhabitants (Lightstone, 2010), and it is the economic hub of southern Africa. The population is, however, not spread equally over the province. Figure 3 indicates the growth point density in urban areas within Gauteng (the areas where most built-up area growth has taken place over the past 10 years). It shows the pressure areas, but most importantly, the regional face of development, where growth knows no administrative boundaries, as can be seen on the borders of the City of Johannesburg with the West Rand, Sedibeng and Ekurhuleni in particular. The map demonstrates that there is little practical division between the municipalities in the area and the city sprawls across administrative borders without much consideration for managerial decisions. Similarly, environmental features and ecosystem services which the province is characterised by do not know administrative or political boundaries. These two elements of the region transmit resource-based decisions to developmental challenges which governmental role players are faced with when strategising towards a smooth-functioning, green-growth-based city region.

Figure 3: The intersection between urban and ecological spaces and administrative borders in Gauteng



Source: GCRO (2011b) (including data from GDARD, GTI and Lightstone).

The province is also faced with a multitude of other intersecting challenges including:

- Ever-increasing urbanisation and migration into its cities;
- Ecosystem pressures and increased inability of the natural environment to absorb stresses;
- Infrastructure challenges and lock-in of the built environment into potentially unsustainable infrastructure types;
- High rates of unemployment;
- Economic dependencies (Shäffler, 2011); and
- Spatial and administrative disparities.

These challenges lead to responses from the provincial and local government spheres in the region, which are often prominent in terms of the nature of urban change that takes place and the pace that it sets for transitions of other similar urban areas in the drive towards more sustainable human settlements.

5.2 Legal and strategic frameworks

5.2.1 National sphere

Strategies and policies are ways in which society attempt to manage how the limited resources that are left on earth should be used. Apart from strategies mentioned earlier, various other legislation, policies, strategies have sharpened this understanding of a green trajectory for Gauteng. On a national level, the Millennium Development Goals Country Report (MDGCR) of 2010 gave rise to a set of national priorities which is based on the vision of protecting the human and natural environment (GCRO, 2011c). The National Governments' 12 Outcome Areas which were released in 2010 further identified a number of outputs and targets that relates to sustainable human settlements and sustainable land use. From a land use perspective, Acts such as the Land Use Management Bill (which is currently in review and yet to be promulgated), the National Environment Management Act (NEMA), Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983), the World Heritage Convention Act (WHCA) (Act 49 of 1999), South African Heritage Resources Act (SAHRA) (Act 25 of 1999) and finally the National Disaster Management Act (NDMA) (Act 57 of 2002) along with the National Disaster Management Framework (NDMF) (2005) all set requirements for management of natural and human resources and risks to settlements and the environment.

5.2.2 Provincial sphere

At the provincial sphere, the Gauteng Spatial Development Perspective (GSDP, 2007), the Gauteng Spatial Development Framework (GSDF, 2011), the Conservation plan (C-plan) and the Gauteng Agricultural Development Strategy (GADS) attempt to define how development should take place on a regional scale. Another example of a document that drives sustainability in the region is Gauteng's Economic Recovery Plan in response to the global financial and economic crisis, which recognises that "increasing awareness of environmental degradation amongst consumers and (the) government has placed the 'green' agenda squarely on the global economic (disposition)". It promises that the province will leverage this green agenda "in collaboration with business and civil society to stimulate new industries and new forms of economic activity … to ensure that environmentally-sustainable options can be linked to job creation, poverty alleviation, and the development of a diverse and resilient economy". Additional strategies that have been developed subsequently include the Gauteng Integrated Energy Strategy (GIES), the Gauteng Climate Change Response Strategy (GCCRS), and the Gauteng Mine Residue Areas Rehabilitation Strategy.

5.2.3 Local sphere

At local government sphere practitioners are faced with the difficulty of not only implementing and adhering to national and provincial strategies and policies, but also local plans. For the land use sector, it include among others local municipality Growth and Development Strategies (GDSs), Integrated Development Plans (IDPs), Spatial Development Frameworks (SDFs), Bioregional Plans, Master Plans such as storm water master plans, Open Space Frameworks (OSFs), Environmental Management Plans (EMPs) and the like. This multitude of documents and guidelines provide ample space for not only misalignment, but also misinterpretation and contradiction.

5.2.4 Reviewing the strategic environment

As expected, the multitude of legal frameworks, regulations, guidelines, strategies and policies that relate to sustainability in South Africa, Gauteng and its municipalities is fraught with challenges of cross-referencing and interacting with each other (and sometimes even counter-acting each other). This relates not only to the range of legislation that influences urban responses to sustainability, but also to the local interpretation thereof at municipal level. Even though there is cross-correlation between legislative, policy and strategy documents, it is still an ordeal for government and municipality officials to comprehend and apply the objectives and targets locally, while at the same time providing for a regionally consistent urban development trajectory. Not only are there sometimes internal contradictions within documents, but even if the same sentiment is expressed across documents, the challenge remains as to how to streamline its implementation transversely through the three spheres of government and apply responsibility for targets and outcomes. Furthermore, the governing system keeps on producing strategies that die a silent death and guidelines that are no more than wish-lists, and projects that aim at greening the developmental process are ‘token projects’ rather than long-term sustainable programmes. The result is uneven or unequal regional growth path. This has implications for urban resilience, since misinterpretations or misalignment of the implementation and outcomes of the variety of documents may have undesired consequences.

It also means that what disaster risk management practitioners assume as self-evident, is not the case in most other government departments. In particular, the difference between legal requirements, strategies and guidelines across municipal borders create an opportunity for disorientation. This not only relate to potential abuse by developers (e.g. in the case where areas has different rules and regulations), but also general confusion as to how for example green infrastructure and ecosystem services should be managed

as regionally-functioning ecological networks, since they do not simply seize to function or change their function once it reaches an administrative border.

5.3 The Gauteng Green Strategic Programme as culmination of efforts towards a sustainable future

After considering the strategies and policies that addresses 'green lens' initiatives in Gauteng over the past few years, it was a logical progression to draft a green strategic programme for the province, that combines the earlier efforts onto one singular track with aligned targets and outcomes. This strategy has been developed during the first half of 2011 by the Gauteng City-Region Observatory (GCRO) in collaboration with the Gauteng Department of Economic Development (GDED), and aims to inform government programmes across the spectrum of departments and at local sphere, so that all government bodies working on green issues are aiming towards the same goals and targets (GCRO, 2011a). Although the process of developing the Programme was fraught with complications, it is another important step on the roads towards sustainable development and increased resilience for the predominantly urban region.

The project started off with conceptualising the terminology and arena of what the strategy programme was designed to address. This included reviews and investigations into what is happening elsewhere in the world in this regard, as well as nationally, provincially and locally, in each of the 9 sectors mentioned earlier. Throughout the development of the programme, it was clear that the concept of green growth remains an undefined entity in the minds of many government officials and because of that, difficult to implement coherently across the spheres and boundaries that makes up the province. Nevertheless, it provides a firm basis on which future sustainable development trajectories can be based. The Programme statements have been categorised into the following groupings:

Table 1: GSP statement categories

Name	Category
Strategy and Regulatory Reforms	S+RR ▲
Resource Mobilisation	RM ★
Research and Development	R+D □
Capacity Building	CB ◆
Public Awareness and Education	PA+Ed ▲
Partnership Building and Collaboration	PB+C

	○
Data collection, Research and Monitoring & Evaluation	D+R+M&E ×
Infrastructure Development, Roll-out and Upgrade	InF D ■
Socio-economic and Market Interventions	SE+M Int ●

Source: GCRO (2011a).

When considering details of individual sector targets and envisaged outcomes, there are often cross-correlating elements between sectors. Where such cross-referencing is applicable, the issues and targets were not duplicated, but referred to. This highlighted the trans-disciplinary nature of sustainability interventions. When considering the land use sector as an example, the envisaged outcome reflects a region with "a more sustainable approach to land use based on more productive landscapes and more efficient, resilient and equitable settlement forms…" (GCRO, 2011a). The economic implications of sustainability in this sector are recognised in the following statement: "By investing in its green infrastructure, Gauteng will (be able to) free up revenue that is spent on disaster recovery and infrastructure costs"… (*ibid*). It is thus clear that the connection between sustainable development and disaster risk reduction has been made on the regional policy and strategy level in the province. An example of some of the targets is presented in Table 2. The table indicate selected elements from the GSP statement that reflect the recognition of critical infrastructure as one of the key elements that influence disaster risk management in the province. It is presented as an example of the proposed programme outputs that are likely to direct the future trajectory for development, and ultimately increased urban resilience and the prevention and mitigation of disaster risk in the region.

Table 2: Land use sector statement issue: Critical Infrastructure

Proposed objective / target	**Proposed key activities to realise target**	**Category**	**Proposed responsibility**
Objective Establish water infrastructure and quality baseline establishment and monitoring	Establish a baseline/status quo by doing a water balance for the province, also addressing water quality in the process	D+R+M&E ×	GCRO, DWA
	Determine a risk plan based on the above, considering alternative water availability	D+R+M&E ×	To be determined after the above activity
Objective Integrate trans-disciplinary perspectives	Increase cross-department alignment and communication during planning through widespread sharing of documents, and open invitations to planning meetings	PB+C ○	Province and municipalities – all departments
	Create a repository (provincially and at municipal sphere) where reports are listed, uploaded and available for easy access by other departments and even private developers	D+R+M&E ×	GDED and municipalities: highest level
Objective Support the view of a longer	Determine changes that are required in supply-chain management and budget processes to support longer term	S+RR ▲	Provincial and municipal

term horison for critical infrastructure development and maintenance	views		procurement offices
	Adjust scoring point system to allow for potentially more expensive longer-term options, as opposed to short-term low-cost implementation and maintenance options. This will support the general transition towards more sustainable infrastructure	S+RR ▲	
	Support technological innovation of alternative 'green' materials for manufacture and use in infrastructure.	R+D □	Blue IQ, The Innovation Hub
Objective Design infrastructure now to cope with increased density in future (cross-reference to urban design issue)	Civil infrastructure to be designed for densification in future, although it may increase the initial backlog to service delivery. It will also cause over-design to existing bulk infrastructure, but is necessary to cope with future demand	InF D ■	Municipal planning departments
	Decentralise systems, e.g. sanitation (for human waste management: cross-reference to the water and sanitation sector): decentralised systems at city block level should be established, many of these systems do not even use water (e.g. composting toilets), therefore the water supply and demand requirements is reduced. This must be addressed as a critical issue: the technology exists and it is scalable – it should just be implemented	InF D ■	Municipal planning departments, Provincial department of housing

Source: GCRO (2011a).

6. Key findings and recommendations of the GSP that pertain to urban disaster risk reduction

The multitude of policy and strategy directives which drives development planning and the potential for sustainability of human settlements are fraught with difficulties. "There seems to be disparity between the implementation of policies strategies and frameworks between 'richer' municipalities vs. 'poorer' ones. The poorer and often outlying ones generally also lack the financial and human resources to integrate and adopt all the provincial guidelines as effectively as their better-off counterparts. The difficulty of documents differing across local spheres remain, thereby making cross-border alignment during implantation difficult, especially when attempting to do matching of spatial land use planning. All of this is exacerbated by the lack of capacity at the local sphere and the difficulty to attract, and retain, the quality and quantity of human resources that are required to operate and implement sustainability-directed efforts.

Since infrastructure, whether it is ecological green assets or engineered, is the foundation of land use it is important to analyse the implication of sustainability in an infrastructural context. Most traditional associations for infrastructure, in particular critical infrastructure include:

- Facilities for electricity generation, transmission and distribution;
- Telecommunication;
- Water supply (drinking water, waste water/sewage, management of surface water (e.g. sluices of dams));
- Agriculture, food production and distribution;

- Public health (hospitals, clinics, ambulances, emergency health services);
- Transportation systems (fuel supply, railway network, airports, emergency access routes);
- Financial services (banking, clearing); and
- Security services (police, military, emergency services, critical governing facilities) (NRC, 2009).

A strong argument can be made that the above listing is a very narrow definition that forgets the critical management thereof by human resources, and the maintenance of these systems through the application of stable procedural and effective budgeting measures. None of the critical infrastructures listed would be able to operate without adequately skilled human resources, money and operational procedures. Critical infrastructure in its broader sense would therefore include the human and natural (i.e. ecosystems service provision), the built environment and information systems content, as well as the systems and governance structures that ensure their effective functioning. These issues are compounded by the fact that service delivery, environmental departments and disaster management units remain largely isolated from one another, operating as silos. The more sustainable infrastructure is, the more it supports sustainable land use and decrease wastage of resources. In a decade of concern about climate change and the resultant increased exposure to disaster risk, all infrastructure, and critical infrastructure in particular, therefore needs to be based on the practices of sustainability. Sustainable and resilient critical infrastructure systems is an emerging paradigm in an evolving era of depleting assets in the midst of natural and man-made threats to provide a sustainable and high quality of life with optimized resources from social, economic, societal and environmental considerations" (GCRO, 2011c).

Even though the afore-mentioned difficulties are real and hard-pressing, there is still a clear indication of commitment from the public sector towards a sustainable future, which will hopefully filter through to the private sector, communities and individual households, which will secure our future tenure on earth. As depicted above, the direct results of the GSP is to be measured through a set of itemised targets per sector that defines how government departments and organisations should interact and what they should be doing to reap some of the so-called 'low hanging fruit' of the sustainability drive. Even though the GSP does not have a sector that specifically deals with disaster risk, the inherent basis of items and targets in the programme aims at reducing risk, reducing vulnerability, increasing manageability and increasing resilience. With 'green strategies' and 'green economy' implementation plans for provinces and municipalities in South Africa being on the card, the disaster risk fraternity should not underestimate the opportunity that initiatives such as this may provide to strengthen the impact that their risk reduction programmes could have on human settlements. At the same time as reducing the severity of hazards by planning and developing infrastructure and settlements in such a manner that they are out of harms' way, a move towards sustainability can increase community resilience, and reduce vulnerability of all persons, even and especially households and societies that are less able to withstand the onslaughts that are associated with

global climate change. The outcome requires a complete transition of everything that we base our cities on: a move ‘from the individual to the collective and from the economy to the ecology’ (Everatt, 2011).

The infrastructure transitions that are associated with a move towards urban sustainability are inherently going to deepen inequalities in society. The discourse of sustainability will not win by moral force alone, and needs to be effected in the form of hundreds of thousands of jobs. Care also needs to be taken to ensure that green jobs are not simply another form of survivalism and that the prejudices that goes along with ‘green jobs’ as low-income and low-skilled work are overcome. There is also the perception that prevails, that ‘green is just a fad’ and sustainability simply another way to be seen as ‘posh’. The question that this paper leaves us with is thus: ‘will the sustainability drive, the green economy, the resilient city – call it whatever you like – take another decade to take hold, just as it took Africa a decade to accept that HIV/AIDS is a reality, or a decade for the world to accept that climate change, no matter what its cause, is a reality; or is there something that we can do, as the disaster management fraternity, to spring-load the process and make the transition faster? Should we just wait for the wheel to turn, or is there something that we can do to get onto the last wagon of the fast-moving train that drives sustainability, before it passes us by entirely.

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