

Green Economy Report

Business Case for Durban's Transformative Riverine Management Programme

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ABOUT THE C40 CITIES FINANCE FACILITY

The C40 Cities Finance Facility (CFF) is a collaboration of the C40 Cities Climate Leadership Group and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. The CFF supports cities in developing and emerging economies to develop finance-ready projects to reduce emissions to limit global temperature rise to 1.5°C and strengthen resilience against the impacts of a warming climate. The CFF is funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), the Children's Investment Fund Foundation (CIFF), the Government of the United Kingdom and the United States Agency for International Development (USAID).

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1. INTRODUCTION

This paper maps out a “significant moment of change” in which the evolving of the eThekweni Municipality’s Sihlanzimvelo Stream Cleaning Programme into a Transformative Riverine Management Programme (TRMP) strengthens eThekweni Municipality’s green economy efforts and offers the hope of an overdue green economy in South Africa (Martel *et al.* 2020).

The green economy re-entered the global policy discourse ahead of the Rio+20 conference on Sustainable Development in 2012. The perspective on offer in 2012 was not new; in 1987 the World Commission on Environment and Development issued its now famous statement, “The environment is where we live; and development is what we all do in attempting to improve our lot within that abode. The two are inseparable” (WCED, 1987). However, the unanimity around the green economy ahead of Rio+20 marked a recognition of new evidence that unless the nature and direction of global economic growth was fundamentally changed, the damage created by environmental crises would threaten not just the entire economy, but also human life. In foregrounding the need for an economy that was “low carbon, resource efficient and socially inclusive” (UNEP 2011) the green economy sought to bolster the sustainability movement by linking its causes and potential solutions to economic activity.

Reconciling economic activity and the needs of a sustainable natural environment in subsequent years proved more difficult than many people had anticipated. There are fundamental differences in the dynamics that govern ecosystems and market economies: ecosystems tend towards diversity and regeneration while markets reward standardisation and replication, economies rewards scale while ecosystems tend to punish it, for example. The Intergovernmental Panel on Climate Change has, more recently, added to the challenge by citing the imperative of alleviating poverty and improving people’s well-being as part of efforts seeking rapid and far-reaching environmental change – effectively linking the Sustainable Development Goals and the climate crisis in a systemic manner (IPCC, 2018, Chapter 5).

The two-way relationship between poverty and ecological degradation is familiar to South African policy makers. South Africa has green economy projects, but the actual economy displays very few of the “low carbon, resource efficient and socially inclusive” attributes necessary to avoid environmental and social damage. On the contrary, the country’s structural dependence on extractive industries, unaccounted-for pollution and socio-economic inequality for its very functioning has now become a source of economic weakness and poor economic competitiveness (OECD 2020). As nations around the world switch to low carbon economies, it will be important that South Africa does not get left behind.

The reimagining and the reform of South Africa's economic system to enable it to simultaneously satisfy social and ecological needs sits at the heart of the country's economic transformation challenge. "Transformation" in this context refers to the change of economic direction, linked to a change in the rules that shape the economy (Termeer *et al.* 2017). It is different to a "transition" which implies a discontinuous shift to a new system, a shift that would be very difficult in practice given the need to maintain some semblance of economic activity so as to support livelihoods (Geels and Kemp, 2007). The long-run goal for any green economic transformation has to be an economy that is better at meeting all people's basic needs and protecting the environment. Given the influence of global finance, and such transformation would have to be supported by a change in the way finance is allocated across the economy (Geddes and Schmidt, 2020).

Up until now, the focus in South Africa has been on project-based precedents that reveal the potential, and win-over business leaders, politicians, financiers and communities to a green economy perspective. The disjuncture between green economy projects and South Africa's mainstream economy, which remains resource intensive and produces high levels of CO₂ per unit of output, has become a source of tension. Bridging the gap from the current economy to a green economy will involve disruption and the process of transformation will itself be risky (CPI 2019). However, the prevailing economy has not only proven poorly equipped to address South Africa's definitive problems of poverty, inequality and unemployment, but has also extracted a heavy toll on the natural environment (DWS 2018). South Africa has reached a point where the risks associated with business as usual are greater than the risks of transformation to a green economy (CPI 2019; Montmasson-Clair, 2020).

2. THE GREEN ECONOMY IN ETHEKWINI MUNICIPALITY

eThekweni Municipality has long served as a leader of South Africa's climate change responses (Roberts *et al.* 2015). The Municipality has documented the economic, social and environmental risks within its jurisdiction and has modelled how drought, floods, sea-level rise and the outbreak of diseases associated with degraded and contaminated natural environments are likely to change under the influence of warmer climates. This track record, together with the city's well-known ecological restoration, waste-to-energy and resilience programmes, positions the Municipality to pioneer South Africa's transition to a green economy and to apply this transition to buffer its most vulnerable communities from climate change and environmental degradation.

eThekweni Municipality's draft 2020/2021 Integrated Development Plan (IDP) is explicit on the need to create a green economy:

"Committed to protecting, restoring and managing the city's ecological infrastructure in order to enhance ecosystem resilience and the ability of our citizens to adapt to persistent change and short-term disasters."

The IDP goes on to identify:

“Ecological infrastructure...as the non-negotiable foundation for all social and economic development – as outlined in South Africa’s own National Strategy for Sustainable Development 2011-2014”.

The IDP document is aligned with the 17 Sustainable Development Goals (SDGs) and 169 targets, as the framework for sustainable development until 2030. In fulfilment of the IDP vision, the Municipality supports a number of green economy projects over and above the riverine management projects described in Section 3.1. These include (eThekweni Municipality, 2020¹):

- **Working for Ecosystems Programme:** The philosophy behind eThekweni’s ‘Working for Ecosystems’ programme aims to build positive interaction between local communities and the environment. The programme seeks to safeguard ecosystem services and manage ecological infrastructure in ways that create skills and employment opportunities.
- **Community Reforestation Programme:** The programme began in 2008 when eThekweni Municipality committed to offsetting the carbon emissions associated with hosting some 2010 World Cup soccer matches. Forest restoration is achieved through the active planting of indigenous trees and removal of invasive alien plants species. Local communities participate through direct employment and involvement in plant propagation. At the end of the 2018/19 financial year a total of 786,894 trees had been planted by the programme. During that same year 99 full-time, 24 part-time, and 512 temporary jobs had been created.²
- **Fire and Invasive Species Control Programme:** This programme uses a local team from the national Working on Fire programme to control invasive alien plants on municipal land. Invasive plants are controlled using both mechanical and chemical means and through the application of controlled fires. Employed workers receive training as part of their job.
- **eThekweni Municipality’s Strategic Environmental Assessment (SEA)** aims to develop an integrated picture of the state of the city’s natural environment so as to plan development that aligns with the underlying environmental condition in order to ensure complementary ecological, economic and human well-being.

¹ http://www.durban.gov.za/City_Services/energyoffice/projects/Pages/GreenKnowledgeEconomy.aspx

² http://www.durban.gov.za/City_Services/development_planning_management/environmental_planning_climate_protection/Projects/Pages/Bufelsdraai-Community-Reforestation-Project.aspx

- **SMME Incubator** supports black-owned enterprises focused on renewable energy and energy efficiency.
- **Sihlanzimvelo Stream Cleaning Programme (SSCP)** creates green jobs through community co-operatives that clean streams in low income, high density residential areas as a mechanism for reducing flooding and stormwater damage to road infrastructure. Teams remove solid waste and invasive alien plants from riverine areas and implement erosion bolsters where required.
- **Green Corridors** is a Not-for-Profit Organisation supported by eThekweni Municipality's Economic Development Unit and Roads and Stormwater Departments that creates green jobs in the restoration of natural environments and establishment of community enterprises in eco-tourism and food gardening. Since 2018 Green Corridors has set about addressing urban challenges of litter, waste collection and contaminated rivers. The KwaMashu Materials Beneficiation Centre is one of the NPO's pilot programmes, and is used to repurpose plastic, glass and biomass waste collected from rivers in the manufacturing of "ocean pavers", "green pavers" and gabions as part of a circular economy that draws in local labour. The programme has also been experimenting with Bokashi composting of the municipality's green waste and supports the establishment of quality recreational spaces in impoverished communities, often in riverine areas.
- **The Pollution Research Group (UKZN)**, based within the local chemical engineering department but partnering with eThekweni Municipality's Water and Sanitation Department and South Africa's Water Research Commission. The group develops innovative approaches to dealing with waste water, including water reclamation, swales that capture and remediate run-off and the black soldier fly project that uses human waste to cultivate fly larvae used as animal feed.

The initiatives mentioned above are among the emblematic projects that comprise eThekweni Municipality's green economy focus. The Energy Office and the Economic Development Unit has begun the critical process of linking these discrete green economy projects into a system that can authentically be called an 'economy' (Geddes and Schmidt, 2020). This transformation will be driven by, and will drive, a reallocation of public and private resources.

3. SIHLANZIMVELO AS PART OF THE GREEN ECONOMY

The particular focus of this study involves the evolution and upscaling of eThekweni Municipality's existing riverine management efforts (including Sihlanzimvelo Stream

Cleaning Programme - SSCP) into a Transformative Riverine Management Programme (TRMP), and ultimately a functional green economic system. This requires both a mindset shift, to begin seeing eThekweni Municipality's riverine areas as economic assets (Taylor *et al.* 2020), as well as connecting the goods and services generated by projects like the SSCP (Figure 3) to investments and value chains in the broader economy. Martel *et al.* (2020) note the "...growing recognition of the green economy potential of Sihlanzimvelo, where waste collected during stream cleaning could be used to close loops, promote the circular economy and create value chains."

The adoption of "transformative" language reflects the potential of projects such as the SSCP to connect communities, the natural environment and the economy and to change the relationship between people and the places they live. Projects on their own do not comprise resilience, and certainly do not make up an economy. Rather it is the connections between projects and the economic system that determines their ability to evolve and survive.

The SSCP was designed by the eThekweni Municipality's Roads and Stormwater Management team to address the build-up of debris in rivers and reduce the associated damage to infrastructure. Over time the SSCP has forged stronger connections with the city's climate change and coastal protection programmes respectively. Whilst still motivated by the need to manage stormwater in Durban, the project has adopted the idea of "transformative riverine management" and been recognised for its ability to provide a range of public and private benefits, including employment and income, protecting built infrastructure, solid waste recycling and biomass recycling. In the process, the SSCP has been able to "*reframe how rivers and streams are seen in the city*" (Martel *et al.* 2020) and has become illustrative of how new perspectives on municipal services can unlock the mutually enforcing interaction between human poverty, ecological degradation and inadequate service delivery, and particularly the manifestation of these problems in rivers and riparian zones (Figures 1 and 2).



Figure 1: Community co-operatives clean streams in high density formal and informal residential areas (source: Gumede, 2019)



Figure 2: Blocked road culverts is a common cause of surface flooding in parts of the eThekweni Municipal Area, often impacting road and electricity infrastructure and socio-economically vulnerable people that have limited resilience to the impacts of such events (source: Gumede, 2019)

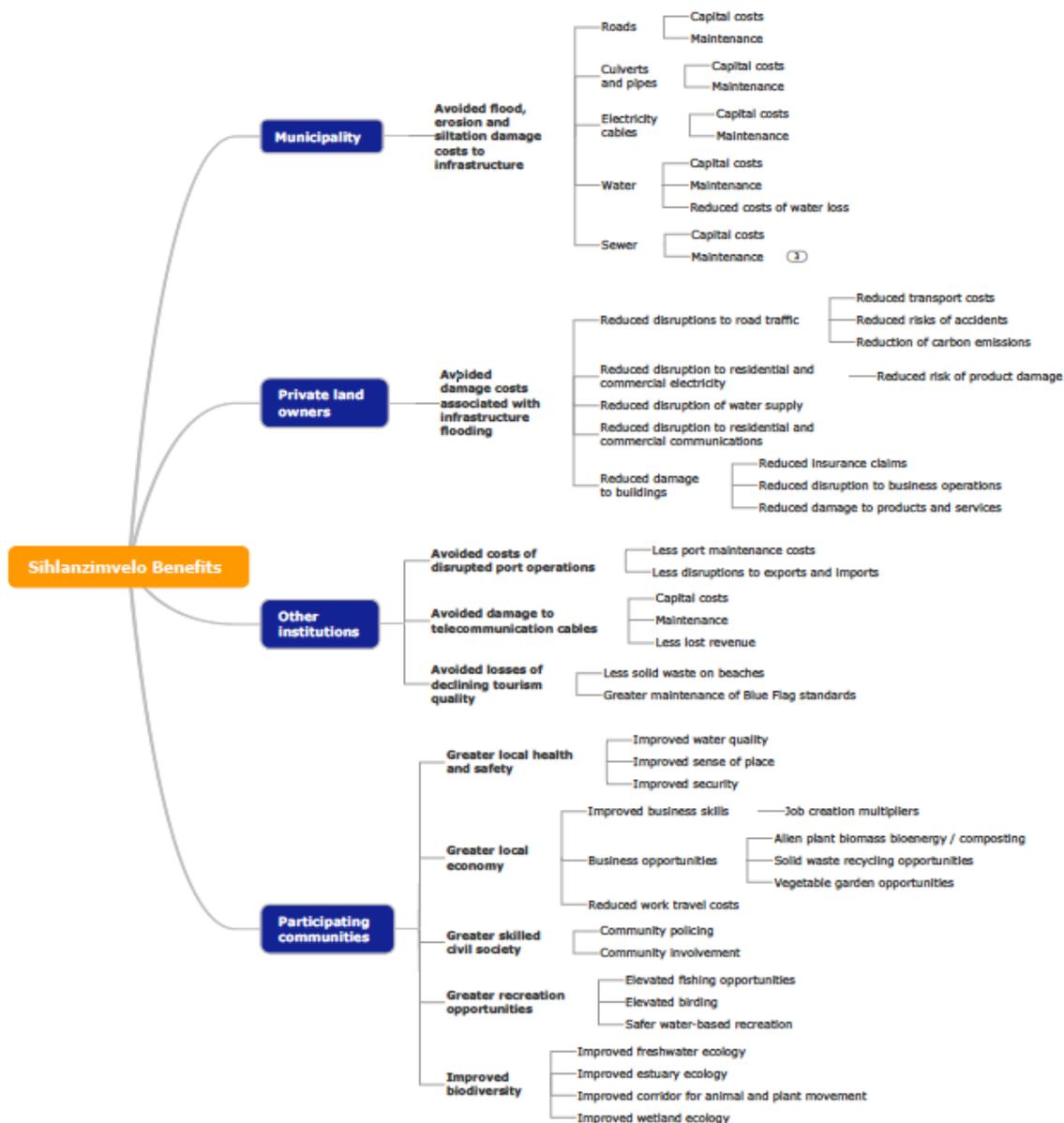


Figure 3: Range of potential benefits from the Sihlanzimvelo Stream Cleaning Programme (source: Myles Mander for this project)

4. GREEN ECONOMY OBJECTIVES FOR THE TRMP

For riverine management investment to make the required connections and achieve transformative green economy outcomes, it should seek to, (i) leverage additional investment from multiple sources, (ii) create new types of work or jobs that contribute positively to the natural environment and social inclusion, (iii) create new value and new partnerships, (iv) improve access to markets and create markets for new goods or services, and (v) facilitate learning and innovation. How eThekweni Municipality's TRMP can respond to these objectives is outlined below and in Table 1:

- **Attracts public and private investment.** Sihlanzimvelo was initiated with public investment from the eThekweni Municipality’s Roads and Stormwater Maintenance Department. In a future TRMP focused on green economic transformation, public finance will remain an ongoing requirement for riverine management, given the catalogue of public benefits these areas generate, but will also crowd-in private and donor resources. This investment may include volunteered time or financial resources spent in establishing new collaborations, clearing privately owned land, the acquisition of material and equipment, bank loans or new donor support.
- **Creates new types of work or jobs.** Access to work imparts income and social identity. As such, it is a key component of social inclusion. One of the cited benefits of the green economy relative to an extractive economy is that the jobs it generates tend to be local and “more reliant on local content” (Borel-Saladin and Turok, 2013). The same jobs tend to be relatively low-skilled and foster a “sense of place” all of which are important in addressing South Africa’s unemployment crisis (Ward and Mudombi 2018; Taylor *et al.* 2020). Moreover, these jobs cannot be easily destroyed by trade wars or similar geo-political shifts in trade policy. A 2011 report by South Africa’s Industrial Development Corporation identified the potential for 462,567 jobs to be created through the green economy over 8 years, with natural resource management (of the type involved in the SSCP) the highest contributor to this number at 232,926. Where the TRMP generates the type of work or jobs mentioned above, it will be unlocking this potential and contributing to a transformative green economy in eThekweni Municipality. The Programme already creates work for over 600 people and saves the department over R22 million in damage to road culverts annually³. On municipal land alone, this could become 1 557 jobs if the SCCP were extended to other municipal land in upper catchment areas, and 2 846 jobs through implementing the TRMP along all rivers on municipal land.
- **Creates new value (including risk reduction) and new partnerships.** Economic systems generate and circulate value. Implementation of a TRMP on municipal land alone has the potential to generate a NPV of R3.2 billion³ over 20 years⁴. This value includes, for example, risk reduction to households and their possessions, risk reduction to public infrastructure linked to lower management and insurance costs, and lower depreciation rates on built infrastructure due to reduced damage during floods. The Disaster Management Amendment Act 16 of 2015 places ecosystem and community-based adaptation at the centre of resilience and risk reduction. Section 53 of the Act provides a strong mandate to municipalities to conduct risk and vulnerability

³ Figures taken from Mander *et al.* (2021) Business Case for Durban’s Transformative Riverine Management Programme, Report produced by C40 CFF and GIZ.

⁴ 6% discount rate.

assessments, develop adaptation plans and allocate budget for adaptation programs. A green economy approach within the TRMP will build on this responsibility to create a low-risk economy, not only at the project or individual scale, but across the eThekweni Municipality. Unlike much conventional economic activity and disaster management, a green economy does not simply shift or reallocate risk within the system but reduces total risk.

The value created by the green economy may accrue outside of formal markets and be difficult to quantify. This includes enhanced tenure security and a sense of place, as well as new partnerships between municipal, private and non-governmental projects and programmes as a function of increasing trust generated through the TRMP. To achieve this green economic system, it seems important that new connections and collaborations are established between the SCCP and the other green economy projects such as the Community Fire and Invasive Species Control programme, Green Corridors and the SMME Incubator for example, to share experiences and innovations.

The ultimate aim should include new forms of capital that can be included in asset inventories; the “ecological infrastructure” referred to in eThekweni’s 2020/21 IDP and in South Africa’s National Strategy for Sustainable Development 2011-2014. Crucially, where new capital or asset classes are created, the ownership of these assets should be more diverse than current asset ownership in the South African economy. The shift to a green economy affords the rare opportunity to create new forms of capital, as well as the opportunity to be intentional about who owns that capital.

- **Access to markets and the creation of markets for new goods & services.** The trading of goods and services in existing and new markets, is one of the features that defines a socio-economic system. For example, the TRMP could attract established markets to key areas where it operates, including the ability to offer riverside tours to visitors or host public recreation events in riparian spaces. It includes ‘offtake agreements’ with enterprises that trade recycled plastic, timber and other biomass sold as an energy feedstock or as a carbon-rich mulch for enhancing soil fertility or for food grown in local community agricultural projects. In other instances, the TRMP may have to create markets, such as ‘carbon markets’ or ‘reverse vending markets’, that reward the reduction of plastic to landfill where it would have emitted methane and carbon dioxide⁵, or enable the reduction of insurance premiums on municipal infrastructure in exchange for river cleaning. At its best the green economy mimics nature in repurposing and recycling all material and nutrients, internalising negative externalities (there is no “waste” in nature) and externalising positive externalities that support and enhance the system that

⁵ See www.crediblecarbon.com

underpins transactions. In this way the TRMP should, as far as possible, support a circular economy. Similarly, a green economy is not as dependent on extracting virgin resources and is better at avoiding the types of economic dead-ends in which plastic collected from water resources is sent to landfills, for example. Precedents for this type of circular economy already exist in South Africa’s sanitation sector (see Figure 4), and in the projects run by Green Corridors that look to repurpose biomass, glass, metal and plastic in enterprises that generate either products or services such as energy.

- **Learning and innovation.** eThekweni Municipality’s IDP 2020/21 is explicit about the need to connect the green economy with ‘knowledge economies’⁶. If the TRMP is to contribute to this economy, then it will incorporate learning. This learning will include the transfer of indigenous knowledge regarding rivers, places, place names and customs to the manner in which rivers are managed, and the upskilling of local river custodians with more conventional river engineering and stewardship capacity. It will also incorporate “mission-oriented” experimentation and innovation (Mazzucato and Penna, 2015) of the type that will enhance the benefits that it generates (Malerba, 2002). The experimentation, learning and capacity building that forms part of eThekweni Municipality’s community reforestation and Green Corridors programmes, for example, already embody this approach, but there are other linkages and scopes for innovation in the solid waste sector, the Human Settlements programme and through WWF’s Green Outcomes Fund which co-finances start-up businesses provided they meet job creation and green outcomes, for example.

⁶ eThekweni Municipality IDP 2021, page 5.

Table 1: Tracking transformation from riverine management projects to green economy

Components of a green economy	Pre-Sihlanzimvelo Status (2008)	Sihlanzimvelo Projects Status 2020	Green Economy Status Required by a TRMP	Critical next steps
Investment				
Public (1,592km of stream length)	Initially began with a small portion of the Roads & Stormwater Maintenance Department's budget and a few pilot project sites	Increased to R35 million per annum and 450km of river length, and saves the Department R22.7 million in avoided culvert damage per year	TRMP applied to municipal land along all eThekweni Municipality's streams and rivers (estimated 1,592km of river length)	Cost saving potential and societal benefits from SCCP upscaling into a TRMP documented and presented to eThekweni Municipality's budget office and funders
Private (1,852km of stream length)	Inadequate data	Not active on private land.	Private sector complies with invasive alien plant legislation on riparian land and observes riparian set-back line legislation. Private sector generates enterprises using spaces and products from riverine management,	Green economy and risk reduction opportunities communicated to donors and investors. Identification of offtake opportunities that can be tendered to the private sector. Identification of risk reduction opportunities to private sector entities.
New work/ jobs				
	67% economically active people unemployed in the region (StatsSA2011 cited in Gumede 2019), 42% of economically active people unemployed across South Africa.	Over 600 jobs created directly in SCCP. Several other donor and corporate funded riverine management projects also active and creating jobs.	Employment of people in enterprises that have offtake agreements with the SSCP. Potential to create 2,823 jobs on municipal land even before new enterprises adding value to material and spaces managed by SSCP are considered.	The viability of the community-based works programmes rests on constructive engagement with community leaders to ensure opportunities do not promote patronage. Training of river entrepreneurs and the formation of new enterprises or co-operatives.
Value created				
Income	"Majority of the working force earn below R19,601-R38,200".	90% of the public investment in SSCP goes to wages and directly back into the local economy. Burden of service delivery deficit lifted by SSCP. Generates R693 per month per person in additional GGP.	Burden of service delivery deficit lifted more substantially by TRMP. Generates R1,322 per month in additional GGP.	TRMP to be recognised as a crucial means of delivering municipal services.
Risk reduced	Escalating municipal infrastructure damage costs experienced in	Demonstrated through Business Case preparation that the total cost the municipality and society of poor	Less loss of infrastructure, less loss of productivity due to service delivery deficits.	This risk reduction tabled in motivating for more budget to extend TRMP.

	relation to poor riverine condition in certain parts of the city.	condition rivers could exceed R375 million per annum by 2040 with climate change.	Coastal resources not compromised by river pollution at estuaries.	
Depreciation rate slowed		R22.5 million per annum in reduced expenditure on culvert damage.		
New products, services and partnerships				
Products developed in a circular economy		eThekwini Municipality supporting initiatives to develop products from materials removed from riverine areas by SCCP	Both organic and inorganic material collected could be recycled or beneficiated in new enterprises. Honey farming and venue management conducted in riparian zone. Riparian zones become an integral part of flood risk reduction and the protection of bulk infrastructure and are actively managed by local communities.	Green Corridors works closely with TRMP to support products and services and links to markets. Government not to run the enterprises but to enable offtakes with entrepreneurs. Municipality could provide market for pavers
New partnerships and collaborations		Several local, regional, national and international partnerships have been established by eThekwini Municipality and others focused on addressing riverine management	Collaborations with researchers regarding plastic in bitumen, biochar modalities, biomass to energy technologies. Riverine management is seen as essential for protecting coastal resources, estuaries and beach-based tourism opportunities. This recognition releases new investment.	Municipality to put out to tender access to the organic, inorganic and riverine opportunities that are generated by the TRMP Continue to grow and develop partnerships supporting TRMP objectives, including research and learning, implementation funding and collaboration at systems scales
Transaction in markets		Biomass: value of timber removed in local biomass markets ranges between R3,000 - R450/ m ³ . Mixed plastic for recycling trades in the region of R300/ ton.	Biomass, charcoal, compost, sorted plastic and value-added plastic (flakes or pavers) traded in local markets.	

		Carbon credit revenue can be generated when plastic is diverted from landfill and used in new recycling processes. One ton of up-cycled sorted plastic generates R800-R2,500 in revenue, but could be used to make pavers or asphalt replacement.	Products developed to fill potholes using upcycled plastic.	
Learning and innovation				
Learning and innovation		<p>7% had education beyond secondary level (Gumede 2019)</p> <p>Several research and learning programmes emerging on riverine management and its links to the green economy</p> <p>Skills development is a focus across several riverine management efforts in the city</p>	<p>New artisans and skills accrued through enterprise development and training on government programmes.</p> <p>Pollution Control Group and other researchers become an integral part of the TRMP.</p>	<p>Department of Trade and Industry, Water Research Commission, Municipality and private sector invest in research and collaborations (“learning by doing”) that reduces flood damage, improves river and water quality and creates new products in a circular economy.</p>

5. POTENTIAL GREEN ECONOMY VALUE CHAINS IN THE TRMP

Modelling and observations undertaken by eThekweni Municipality suggest that 70% of the debris causing blockages in riverine systems in the eThekweni Municipal Area is made up of alien vegetation, while 30% is solid waste. In a TRMP, this material would not only be removed from watercourses and riparian areas but, as per the vision of the Green Corridors programme, re-purposed and reused challenging the whole notion of “waste”. The eThekweni Municipality is unlikely to be the agent of every innovation required to make this a reality and need operate green economy enterprises itself. Instead, it could allow local enterprises rights over the collected material and provide a market for the beneficiated compost and Bokashi at the city’s parks and similar markets for the “pavers” used on the city walkways and bicycle paths. In this way the municipality will not risk the “moral hazard” of second-guessing the technologies and ideas available to green economy entrepreneurs and will not take direct responsibility for the success of green economy enterprises. This way, the eThekweni Municipality will crowd-in private sector investment to the riverine stewardship process by allowing green economy entrepreneurs access to recovered material that could then be used to start new private enterprises.

5.1 Organic Material

Invasive alien plants removed from riverine areas usually include Water Hyacinth, Spanish Reed, *Chromolaena odorata* and fast-growing woody species such as Syringa and Black Wattle. Most organic material removed from South Africa’s rivers ends up on the banks of the river or in municipal landfills where it composts and ferments releasing a combination of CO₂ and methane. The nationally run Expanded Public Works Programmes that set up furniture-making cooperatives made from wood removed in water catchments have experienced mixed results, often struggling to find markets for their furniture and becoming dependent on government support. It is proposed that the eThekweni Municipality does not take responsibility for end products or new industries that utilise the organic invasive alien plant material removed from riverine areas, but rather enable the creation of businesses that utilise this resource through offtake agreements.

Green Corridors already pioneers “manufacturing units” that seek to add value to the biomass removed from eThekweni Municipality’s rivers. Efforts include:

- Bokashi manufacturing through combining micro-organisms, biomass from invasive alien plants or cleared from rivers, manure and spent brewery grain. Bokashi composts anaerobically in polybags and without the need for turning and produces a growing medium that is more fertile than most composts. Companies such as Earth Probiotics in South Africa have already established commercially successful Bokashi enterprises and demonstrated its value.

- A prototype for a “green concrete” retaining wall block in which sand is displaced by up-cycled plant fibre (cleared “Spanish Reed” is ideal). The resulting block is lighter than conventional concrete blocks and its production has the potential to reduce damaging sand mining. Where successful, up-cycled biomass has the potential to be used in various green composites as a substitute for heavier material that rely on extractive industries.
- Green Corridors is also experimenting with the use of up-cycled Syringa wood chips as a feedstock in a 5KVA generator which, if successful, could be scaled to larger generators.

In addition to those enterprises being trialled and pioneered by Green Corridors, South Africa has enterprises that upcycle biomass and could utilise the types of organic material removed from rivers under the TRMP. These include:

Composting:

- Woody and non-woody invasive alien plant material that has been chipped provides an excellent source of compost that can be used to support local agriculture, landscaping and the rehabilitation of degraded soils, or as a mulch in City parks. Effective composting depends on keeping organic material aerated, and as such is well suited to manual labour that turns compost regularly. It can also, however, be conducted at scale, as illustrated by Reliance Compost, one of South Africa’s leading composting companies, employing over 200 people and deploying a combination of labour intensive and mechanised technologies.

Commercial composting depends on a steady supply of green waste, but Reliance generates revenue by both collecting green waste and selling a variety of composts that range in value from R150/m³ to R800/m³.

Composting green waste is safe but requires open land.

The environmental value of compost is contained in its ability to:

- (i) Reduce the pressure on expensive municipal landfills. Reliance Compost claims to have kept 20 million m³ out of the City of Cape Town’s landfills.
- (ii) Enhance soil organic carbon, which in turn improves water infiltration and soil fertility and can counter soil erosion. The addition of woodchips sourced from AIPs in the Western Cape’s LandCare project is known to have protected farmers from the impact of the recent drought, due to the ability of soil organic carbon to retain soil moisture.⁷

⁷ In line with the Conservation of Agricultural Resources Act (1983), South Africa has been able to spend public funds to support farmers in soil conservation projects.

- (iii) Reduction of greenhouse gases from municipal landfills, generated when organic material decays anaerobically. Reliance has received money for its “carbon credits” that it used to supplement revenue from waste collection and the sale of compost.

Biochar production:

- Biochar is made through the process of pyrolysis – the burning of biomass under conditions of low or little oxygen. The result is a product that absorbs CO₂ and other chemicals. When placed in the soil, biochar can enhance soil organic carbon and soil fertility. There is also evidence that biochar, when added to manure lagoons at stock farms, traps ammonia and methane (Dougherty *et al.* 2017). Once it has trapped ammonia, methane and other nitrogen run-off the same biochar can be added to soil as a source of nutrients, and to reduce nutrient leaching (Wang *et al.* 2018). The making and application of biochar qualifies for carbon credits (using the Clean Development Mechanism Methodology AMS III.D and AMS III.L) due to the reduction of methane from animal husbandry and the securing of stable soil carbon instead of decaying organic matter (effective pyrolysis preserves 22-25% of the original biomass. This is biomass that would have otherwise decayed releasing carbon dioxide and methane).

A study commissioned by the South African Department of Environmental Affairs identified “pros, cons and uncertainties” around biochar potential, but also noted the opportunities for private enterprise particularly where a mobile kiln was available⁸.

Organisations such as Living Lands and Biogrow are already making and using biochar in South Africa.

Activated Carbon:

- Activated carbon is made when natural, carbon rich material (charcoal, wood, or nut shells) is exposed to steam or chemicals that opens the pores of the charred material. The porosity and adsorptive properties of the activated carbon material is used to remove pollution from liquid or air. As such activated carbon is applied in the purification of water and air, extraction of minerals from mine tailings and in a range of cosmetic and colour removal products.

Rotocarb, a South Africa leader in the production of activated carbon currently produces 100 tons a month, and sells this carbon at over R20,000 per ton. The same company estimates that South Africa currently imports 700 tons of activated carbon a month. This amounts to an import value of R200 million per annum.

⁸ http://tgh.co.za/case_studies/biochar-potential-in-south-africa/

5.2 Inorganic Material

5.2.1 Market Opportunities

The removal of inorganic material such as plastics, glass and metal from rivers provides both an ecological benefit for the riverine area and, once sorted, a feedstock for a range of activities.

More than 270 million tons of waste are recycled around the world annually, supporting a \$200bn industry. Almost certainly a much greater amount is repurposed or reused. South Africa has a small but growing plastics and metal recycling industry that has proven useful in creating the type of local, low-skilled work that unemployed people can do.

The prices offered for recyclable plastic material have proven volatile (loosely linked to the oil price). The global recycling market suffered in December 2017, when China and Hong Kong who had previously purchased 60% of the world's recyclable material, cut their purchases to 10% citing concerns over dirty and hazardous material.

The removal of plastic, glass and metal from rivers is unambiguously good for river health, but the material itself can be sold, as can the carbon credits that arise from the avoided emissions associated with the mining and production of virgin material: a ton of recycled aluminium avoids the release of 9.8tCO_{2e}, while a ton of recycled PET avoids 0.855tCO_{2e}, and a ton of "mixed plastics" avoids 0.805tCO_{2e} according to DEFRA's lifecycle analyses (Credible Carbon, *pers. comm*, 2020).

Typically, plastic recycling requires scaled industrial plants capable of turning recovered material into plastic flakes that can be used in everything from shoe soles to a bitumen replacement in the construction of roads and the making of paving stones and eco-planks. The use of recycled plastic in making bricks and paving stones is becoming commonplace in many countries and is being pioneered in South Africa by the Centre for Regenerative Design and Collaboration (CRDC), who claim to make bricks that are 10% stronger, 8-16% lighter and much lower in CO₂ emissions than cement bricks.

The collection and sorting of plastic material opens opportunities for micro-enterprises, as has been demonstrated by the Wildlands Conservation Trust's "wastepreneur" programme, which is implemented in parts of the eThekweni Municipal Area. It also creates the scope for "reverse vending" whereby people that deposit plastic or cans in a designated repository are rewarded with cash, airtime or food and travel vouchers, effectively crowd-sourcing plastic recycling.

5.2.2 Plastic Recycling Value Chain

South Africa was relatively slow to support its plastic recycling industry, but the weight of recycled material has grown by over 60% in the past decade (6.7% per annum) and South Africa now recycles an estimated 42% of its plastic (PlasticSA, 2018). In spite

of this, 34% of South Africans remain without access to formal solid waste services and much of their solid waste ends up in drains and rivers, exacerbating flooding and infrastructure damage.

Removing this plastic prevents drains and culverts becoming blocked and supports functional ecosystems, but also provides a source of material that can be used in recycling (Figure 5). South Africa's recycling industry provided an estimated 7,800 jobs in 2018 and injected R2.3 billion into the "informal sector" (PlasticSA, 2018).⁹ KwaZulu-Natal is already estimated to be home to 59 plastic recycling enterprises each processing an average of 1,000 tons per annum (GreenCape, 2020)¹⁰.

Rivers and drains represent a difficult source of plastic material to "sort" and plastic collected in this way tends to get sold as "mixed plastic". Mixed plastic generates revenue of R800 - R2,500/ ton for recyclers and small-scale waste sorting in South Africa typically requires 1 person per 100 tons of waste per year. Clearing and maintaining plastic over the 1,592km of river envisaged under the TRMP could generate an estimated 1,000 tons of recycled plastic over three years valued at R800,000 – R2.5 million if sold to plastic recycling companies.

More recently, however, the same plastic and car tyres have been ground into pellets and then used as a material in furniture manufacturing, paving bricks and road construction. Upcycled high density polyethylene pellets are used to augment bitumen binders in asphalt roads. This augmentation not only reduces the greenhouse gas intensity of bitumen but can make roads more resilient to high and low temperatures (more "visco-elastic"). Shisalanga was the first company in South Africa to experiment with plastic pellets made from milk bottles when constructing the MR577 in KwaZulu Natal. Roughly 118 two-litre milk bottles are used per ton of asphalt road as part of a 6% additive to the bitumen in that road (Nortjé and Seforo, 2019). A similar approach has been used to augment bitumen in a Jeffrey's Bay road where the plastic pellets used were imported from Scotland by the company MacRebur. Additional research is required for this means of road-building to become mainstream or a major offtake for recycled plastic, but Green Corridors is already experimenting with upcycled plastic and glass products that could be used to fill potholes.

Bricks or pavers produced by plastic, if made correctly, are more durable than conventional paving bricks, they do not absorb water, have a high co-efficient of adhesion (0.7 – 0.8 with rubber when dry) are anti-fungal, and can be produced at 80% of the cost of conventional bricks and moulded to accommodate cavities for electrical cables, gas pipelines and the like (Lysyannikov *et al.* 2019). A recycled plastic pavers project has been implemented as a partnership between eThekweni Municipality's Economic Development Department, Roads and Stormwater Management Department, and Green Corridors. Plastic waste collected from litter

⁹ <https://www.bizcommunity.com/Article/196/703/194589.html>

¹⁰ https://www.greencape.co.za/assets/Uploads/WASTE_MIR_20200331.pdf

boom sites in rivers (often plastics with low recycling value) is recycled with crushed glass and sand to produce pavers that are thinner and lighter than concrete alternatives and can be produced and sold at prices similar to conventional pavers. Pavers can be made from soiled Low-Density Polyethylene, High Density Polyethylene, Polypropylene and film, but not PVC or PET, and the diversion of this material saves landfill airspace and the need for new landfill megaprojects.

The KwaMashu Materials Beneficiation Centre is a pilot project of Green Corridors which works on developing various waste recycling approaches methods, including the creation of plastic pavers. Examples include EcoArena, EcoPlanks, TrashBack, Cheric Energy biodigesting for electricity and potable water.

The key for all 'wastepreneurs' involves connecting to a market – a company that is prepared to purchase their collected and sorted waste – that can accommodate the scale supplied at a reasonable price. There are also challenges around safety, particularly where hazardous material is being handled. Unilever has purchased wastepreneur's produce in KwaZulu-Natal in the past. As awareness around plastic pollution grows and space for new landfills becomes harder to find, there is an increasing number of plastic recycling companies ensuring that plastic polymers remain in a circular flow and do not enter landfills.

At current prices (R800-R2,500 per ton) the revenue generated by any plastic recycling enterprise is much too small to sustain riverine management, but the ability to generate material for a private enterprise is one example of the value creation that should be used in justifying the 'shortfall' between the SCCP budget (R35 million per annum) and the reduced cost of culvert damage that was the exclusive focus of cost estimates in this project (R22.5 million). Moreover, the sale of the rights to biomass and inorganic waste collected from rivers in the TRMP could be used to reduce that shortfall.

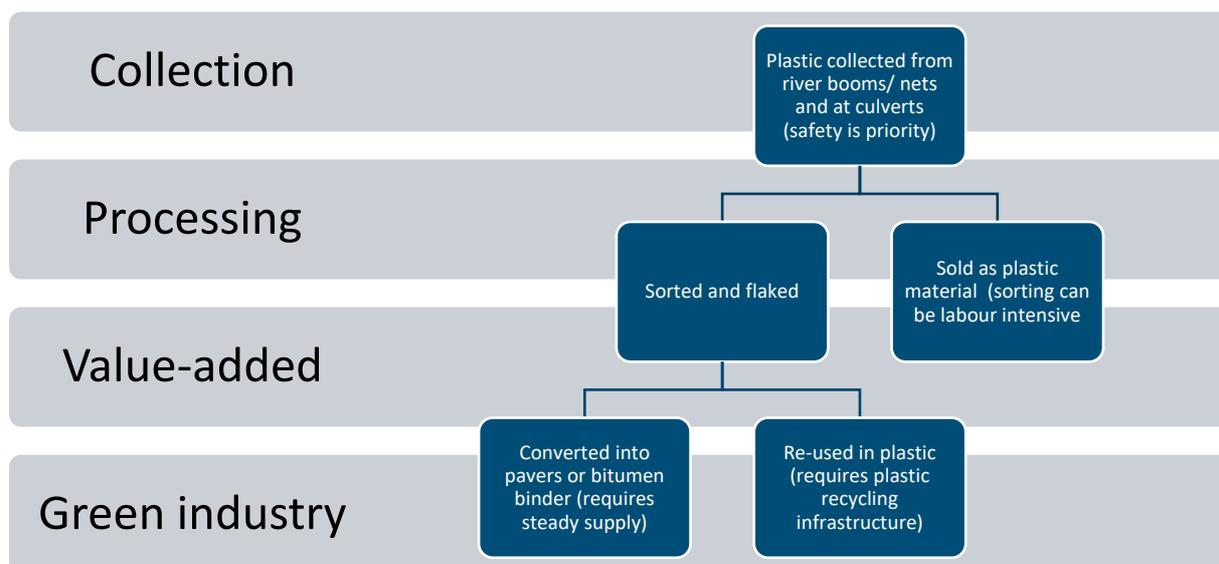


Figure 5: Steps in the plastic recycling value chain

5.3 Productive use of Riverine Areas

Protecting land adjacent to streams and rivers from urban transformation secures a flood buffer and allows riparian ecosystems to thrive. It promotes access to these restored areas for various productive uses, including recreation, eco-tourism and agriculture. In some regions of South Africa, the upkeep of municipal commonage is supported by a range of line departments, creating a combination of work and commercial opportunities for users of the commonage (Anderson and Pienaar, 2003).

Degraded riverine areas that have been cleaned of invasive alien plants and litter (for example through the various Case Example projects studied in the baseline assessment) are often reported to become used by local communities for vegetable farming and recreation (Taylor *et al.* 2020). These areas could be demarcated as municipal commonage and be managed by common-resource collectives to lease the land for activities such as vegetable farming and grazing, indigenous vegetation pollination sites and honey farming, ceremonies and sporting events, eco-tourism and environmental education activities. Ensuring that these activities comply with environmental legislation is key protecting the health of the adjacent riverine ecosystems and ensuring the safety of the enterprises. For example, adoption of conservation agriculture and establishment of recreational parks or environmental education facilities will have to be designed to withstand natural flooding and drought cycles. Green Corridors already has an experimental agroecology project that treats stormwater run-off by filtering it through reedbeds and sand and gravel filters before using it as irrigation water in agricultural projects. Using riparian spaces to create ‘resilience’ value in this way will help to ensure sustained interest and investment in their management by local communities and landowners.

5.4 Riverine Areas as Infrastructural Assets in their own right

Once the multitude of goods and services produced by rivers is documented and valued, a case emerges for them as pieces of valuable ecological infrastructure. Ecological infrastructure is akin to conventional municipal infrastructure, being critical for the provision of municipal services, and requiring maintenance in ways that generates employment. Where this is the case, eThekweni Municipality would be able to record their ecological assets on the municipal asset inventory, making use of tools such as the natural capital accounting system that is being advanced in South Africa by StatsSA and SANBI (Driver, 2019). This in turn could enable the use of infrastructure grants for the creation and upkeep of riverine areas, where this activity can be shown to yield a municipal service.

Viewing rivers and other pieces of natural capital as assets is an essential part of the green economy. However, efforts to advance this approach need to be cognisant that rivers and streams may have intrinsic value that is worth protecting in its own right, even when that value is difficult to commodify and record alongside other infrastructure assets (Vatn and Bromley, 1994). The complex and highly connected role that rivers and streams play in supporting the ecological stability and functioning of the natural environment on which all life depends, will never be fully captured by economic models. In this sense, investing in functional rivers and streams (and other aspects of the natural environment) not only generates goods, services and employment opportunities, but is an essential component of supporting life.

Given that markets are not yet capable of imputing all of this value, the responsibility falls to public entities; by the time the next flood (or drought) arrives in Durban it will be too late to invest in healthy streams and rivers capable of absorbing the worst impacts of a flood and saving damage to livelihoods and infrastructure. It is the same complex but intrinsic role of rivers that tends to lead to un-anticipated benefits (sometimes called “co-benefits”) when well-planned investments are made in their restoration, and the connections between healthy and productive people and a healthy and productive natural environment are unlocked (Boltz *et al.* 2019).

6. TRMP AS PART OF A POST-COVID ECONOMY

In economic terms, the Covid-19 pandemic has enforced a supply-side shock in the form of a “lockdown” that precipitated a dramatic decline in demand through retrenchments, bankruptcies and loss of savings (Krugman, 2020). Unlike a conventional recession emanating from weak demand, the economic fall-out from Covid-19 was induced in order to save lives. Knowing this, national governments everywhere began thinking about stimulus packages as soon as they began enforcing lock-downs, borrowing concessionary finance where this is available (Hausmann, 2020). The sustainability of this debt will be enhanced where borrowed money can be used to create assets. The focus during the stimulus phase will be on growth, but it

cannot be the same mode of growth that has created the systemic social and environmental risks we are now facing.

The design of stimulus packages offers a rare chance to restructure the economy; something long overdue in South Africa (Montmasson-Clair, 2020; OECD 2020). Effective stimuli will: (i) be able to be mobilised quickly (ii) keep money circulating in the real and local economy in the short term, (iii) not hand money to sectors in lockdown that cannot absorb the stimulus, (iv) not hand money to sectors at risk of spreading the disease through unavoidable proximity in working quarters (v) not support sectors, such as coal, that have been identified as unsustainable and in a process of phased decline (vi) generate high economic multipliers and co-benefits (vii) not easily be off-shored resulting in a loss of local impact. In its discussion document prepared by the ANC's Economic Transformation Committee, South Africa's ruling party called for the Covid-19 response to, "Aim at strengthening the resilience of the water sector.... In order to protect lives and livelihoods." (ANC, 2020). Providing stimulus money to people working on the restoration of rivers and the reduction of flood risks meets all of the requirements for an effective COVID-recovery initiative and represents a sure way of ensuring that stimulus money re-enters the economy immediately and systemically – poor households supplying labour restoration schemes have a higher propensity to consume, rather than save and money in their hands will immediately support the producers of food and essential materials in the real economy.

From early in the response strategy it became clear that fund disbursements that relied on existing programmes, such as the SSCP and others studied in this Baseline Assessment, were able to disburse money quite quickly. In contrast, when disbursements required new systems to identify and appraise applicants, relatively few applicants have received any support. The important point, that should not be lost, is that labour intensive public investment in projects such as the TRMP, should form a priority in the wake of COVID-19.

7. CONCLUSIONS

This Green Economy Report has been prepared in support of the preparation of a Business Case for Durban's Transformative Riverine Management Programme (TRMP). It identifies the potential that a green economy perspective offers to close the gap between money spent on the existing SSCP and the narrow benefits that SSCP returns by way of avoided or delayed culvert damage.

Self-evidently, the SSCP already offers much more than avoided culvert damage. Key to understanding and harnessing this value (much of which is currently non-financial value) is the conversion of eThekweni Municipality's existing climate response and green economy projects into a coherent economic system. This conversion requires attention to how these projects:

- Attract and redirect public and private investment
- Generate new employment and types of work
- Unlock new value (including risk reduction) and partnerships
- Create new markets (e.g. carbon market) and market access for new goods and services
- Embrace learning and innovation

The report identifies opportunities to use organic and inorganic material collected from rivers under the proposed TRMP in a range of value-adding enterprises. It also identifies the potential to use rehabilitated riparian spaces as agricultural land, recreation facilities and ecological buffers.

The report suggests that the eThekweni Municipality's role is not to run these green economy enterprises but to regulate access, encourage partnerships and in some instances provide an offtake market for the compost, pavers, biochar, electricity and other goods and services that could be produced with remediated material by the TRMP. The graduation of the TRMP into a functional green economy not only creates the type of work that unemployed South Africans can access but offers the country a much needed example of how South Africa's problematic prevailing economic structure might be transformed to be more inclusive, more resource efficient, more climate resilient and more competitive. This is a transformation that has become even more critical in the context of the Covid-19 pandemic.

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