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Transitioning to climate-resilient development pathways in South Africa: What does it take?

Significance:

The notion of climate-resilient development pathways (CRDPs) is gaining traction across science and policy communities as a systemic approach to mainstreaming climate action in the face of changing conditions. This Commentary builds on a recently published review paper reflecting on efforts to move from conceptual development and policy goal setting to operational practices that progress CRDPs. It acknowledges the important convening role played by South Africa's Presidential Climate Commission and calls on the science community to inclusively co-produce the evidence base needed to negotiate and implement CRDPs across scales that unlock a just transition to sustainable well-being for all.

Introduction

The concept of climate-resilient development pathways (CRDPs) is gaining traction internationally, across the science and policy communities, as highlighted in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.^{1,2} CRDPs offer a systemic approach to planning climate action, both adaptation and mitigation, as integral to long-term development by preparing diverse portfolios of actions with flexibility to switch strategies in the face of changing conditions.³ The question is how to operationally practice such an approach. This Commentary is a reflection of a paper, published in the journal *Current Opinion on Environmental Sustainability*, which reviews how CRDPs are designed and applied in Global South contexts.⁴ The review particularly focused on how inequality is dealt with when weighing up priorities and trade-offs, and how climate science is inter-woven with other forms of knowledge in making decisions. The review was undertaken to inform the development of a CRDPs guide, commissioned by South Africa's Presidential Climate Commission (PCC), to support joined-up efforts at realising the ambitious climate and development goals South Africa is striving to attain, in the face of considerable institutional fragmentation and legacies of marginalisation and carbon-intensive industrialisation.

Can the notion of pathways be mobilised across disciplines, policy domains and fields of practice to help understand and act in concerted ways to (rapidly) transition our societies, ecological and technical systems to be more equitable, just and environmentally sustainable? The growing impacts of climate-related events, such as severe flooding in KwaZulu-Natal and multi-year droughts in the Eastern and Western Cape, highlight that our systems are not resilient enough to adequately provide safety and well-being for most people and the infrastructures and ecosystems on which they rely. Working with the idea of climate-resilient development pathways can help draw together diverse actors to negotiate and coordinate actions to set human development (understood as inseparable from earth systems evolution) on a new trajectory, as laid out in the global Sustainable Development Goals (SDGs) and South Africa's National Development Plan.

How CRDPs are being operationalised elsewhere

The question of the utility and applicability of CRDPs is being explored in South Africa through work coordinated by the PCC. Part of that work involved looking at how various pathways approaches have been operationalised elsewhere in the world. Particular attention was given to other Global South contexts, grappling with similar issues to South Africa, associated with high socio-economic inequality, widespread informal land uses, unregulated construction and economic activities, rapid urbanisation, and many people getting by without adequate provision of public services. A systematic review of published academic literature found that many applications of pathways approaches are still in the proof-of-concept phase.³ This is especially the case in Global South contexts, where relatively small, contained efforts have been made (and reported on in the published literature) to show how pathways thinking can be applied to potentially support decision-making. There are those using a performance-oriented pathways approach, working to quantifiably measure the effectiveness of various strategies in achieving well-defined system performance criteria. For example, for Suzhou in China⁵, Singapore⁶, Central Cebu in the Philippines⁷, Karnataka in India⁸, and the Hablehroud River basin in Iran⁹, modelling of river catchments has been undertaken to assess flood-reduction interventions and water supply performance under a range of climate change, land use and population growth scenarios. Analyses were done to evaluate combinations of interventions such as bioretention swales, porous paving, green roofing, rain tanks, drain widening, diversion canals, retention ponds, additional groundwater wells and boreholes, new dams, and desalination plants. Combinations of options were assessed against performance criteria under various scenarios to identify robust, flexible, and cost-effective pathways.

Others have taken a less computational, more stakeholder-oriented CRDPs approach primarily aimed at engaging diverse actors in considering and prioritising various development options according to how climate-resilient and carbon intensive they are. For example, in Indonesia's Nusa Tenggara Barat Province¹⁰ and Nuwakot in Nepal¹¹, researchers have facilitated participatory processes with government and community representatives to collectively determine development objectives and evaluate options against experienced and projected climate risks. In addition to considering physical risks, social drivers of vulnerability were also identified, and options sought that address patterns of economic marginalisation and social exclusion. These options include facilitating access to finance for women-led cooperatives and supporting subsistence farmers to become semi-commercial farmers through increasing market access, improving marketing, introducing new seed varieties, and training on pesticide use.¹¹

We chose to focus our review on pathways approaches being implemented in Global South contexts, but there is also a substantial body of literature on efforts implementing adaptation and climate-resilient development pathways in the Global North, notably in the Netherlands, Australia, New Zealand and the United Kingdom. Taken together, this growing body of work offers new insights into concepts of thresholds, signals, decision triggers, lead times between decisions and full operation, path dependencies and transitions from a complex systems perspective, all of which can help guide decision-making under deep uncertainty.¹² One of the challenges identified across many of the studies is how to ensure equity is kept front and centre when applying pathways approaches and working to drive change towards just and inclusive pathways of sustainable and climate-resilient development. The tendency is for dominant actors and the priorities of powerful incumbents to continue shaping the agenda, such that pathways perpetuate marginalisation and disempowerment of those without a large stake in the market economy, such as those practising subsistence farming or engaging in informal urban livelihoods like waste reclamation and recycling.¹³ If CRDPs are to stimulate a just transition, then the conception and design of the pathways, and the decisions regarding inevitable trade-offs, need to be inclusive and just in their process and outcomes. This requires negotiating and assimilating (as resolving is unlikely) fundamental disagreements over what constitutes well-being and evaluating effective means of achieving well-being for all.

Shifting South Africa's development pathways

As municipalities struggle to recover from crippling floods, droughts, fires, COVID-19, load shedding, service delivery protests and political instability, and international investors crowd into the alternative energy space in South Africa (including manufacturing green hydrogen and mining manganese and other minerals and metals for batteries), we need to think holistically about development pathways. We need to be designing and investing in development pathways that are attuned to what we carry with us from the past and to the multiple possible futures we are preparing for and bringing into being with the choices we make and actions we take, or shape. How do we combine climate adaptation and mitigation investments into development pathways that give everyone opportunities for a healthier, more sustainable life, especially for those most marginalised to realise their aspirations, including those living with disabilities¹⁴? A development pathway that is climate-resilient involves a sequence of public and private actions or interventions that steer or nudge the emerging development trajectory towards a safer, more equitable and less carbon intensive future. For example, this might include investing in community-based early warning systems for extreme weather events, planting more drought-tolerant crops, rehabilitating coastal ecosystems to buffer storm surges, building green hydrogen infrastructure, reusing wastewater, employing local teams to clear solid waste and invasive plants from waterways, and so much more. Many of these actions are associated with work opportunities. The key is reconfiguring financial models to make them sustainable. CRDPs are place-based and context-specific with interactions across various spatial and temporal scales, requiring long-term systems thinking for coherent decision-making and coordinated actions.

Many efforts to foster climate-resilient development are already underway in South Africa, as well as elsewhere, but they remain fragmented. We need to continue building bridges between the various pathways-related initiatives to strengthen an integrative, inclusive and evidence-based approach. This requires strengthening the shared evidence base of localised emissions sources, mitigation measures, climate hazards, exposure, sensitivity, adaptive capacity, coping and adaptation measures, and impacts. For example, evidence of changing rainfall intensities and wet spell durations across a municipality, spatial data of locations within the municipality exposed to inundation and erosion, characteristics of households, businesses and infrastructure highly sensitive to inundation or erosion if certain thresholds are exceeded, measures taken to divert floodwaters and protect property, people and animals, and details of flood-related impacts experienced and associated costs. In addition to physical damages, this evidence needs to extend to psycho-social dimensions, such as the psychological burden of financial pressures after widespread crop losses or the social consequences of living in a temporary shelter for months after losing one's home to floodwaters. More aggregated

and accessible evidence of the measures taken to reduce climate-related impacts and minimise emissions, with the associated costs, benefits and capacities required to implement and maintain the measures, helps build the case for similar investments elsewhere and weighs up potential synergies and trade-offs between options. For example, there are potential synergies between initiatives that remove solid waste blockages from rivers (to reduce flooding impacts) and those that support local entrepreneurs making products (like outdoor pavers) from reclaimed waste materials. Potential trade-offs need to be suitably appraised against policy objectives, local priorities and system resilience; for example, dam building to reduce water scarcity and drought risk in one area that results in further increasing water scarcity downstream, or building seawalls to protect commercial infrastructure, like hotels, that worsens erosion and inundation further along the coast.

Exciting efforts are already underway working to translate the CRDPs guidance into operational plans through extensive multi-stakeholder processes, for example in the OR Tambo District and Nelson Mandela Bay Municipality in the Eastern Cape, as well as sectoral adaptation pathways being developed for the Western Cape. There is rich learning emerging from these efforts and communities of practice forming between committed change-makers seeking to learn together and support each other, across government, consultancies, academia and civic organisations.

Conclusion

CRDPs are an attempt, bubbling up in various places around the world, to bring together the sustainable development agenda with the climate change and disaster risk reduction agendas, linking bottom-up initiatives with large-scale planning efforts.¹⁵ CRDPs provide a means of coordinating the diversity of actions required to transition to a more just, inclusive and sustainable development trajectory that keeps the global climate system within a range suited to human habitation as we know it.

The review piece published in *Current Opinion in Environmental Sustainability* is an extension of work done with the PCC to develop guidance on co-creating climate-resilient development pathways in South African contexts. The guidance includes a piece on climate information needs and services for developing and navigating pathways, and on the organisational and institutional capacities required to enact a CRDPs approach. The work to build these capacities and co-produce the necessary evidence base is underway, but there is much to be done and learnt. Municipal and provincial governments are on the frontlines of having to allocate resources, deliver public services and respond to extreme events – like floods, heatwaves and droughts – in ways that protect the most vulnerable and enable the private sector to function and grow. Many are struggling and failing to fulfil existing functions, without the burden of increasing climate risks. Coordinated support from the scientific community to understand and monitor climate-related risks and evaluate the efficacy of various adaptation and mitigation measures is needed. Municipalities and the private sector hold some of the data or means of data collection needed to make such analyses possible. The PCC, together with relevant governmental committees and forums formalised through the *Climate Change Act*, provides the institutional architecture through which to cohere such initiatives needed to navigate more climate-resilient development.

The CRDPs approach provides a lens through which to weigh up and sequence development choices and interventions to navigate the choppy waters ahead and can act as a kind of glue to bond together what we are doing with what others are doing, across South Africa and beyond. CRDPs can be mobilised to weave together practical, experiential, indigenous, technical, scientific and policy knowledge to iteratively assess and monitor risks, evaluate and sequence combinations of options, and link locally grounded initiatives with macro-economic interventions, extending across election cycles into multi-generational timescales. Using the CRDPs approach requires tackling power imbalances, mistrust, short-termism, self-centredness, and organisational silos. This is where the role, capacities and convening power of the PCC is key and where academia has a role to play too. We need to move the thinking and science forward in ways that ensure democratic and corporate decisions are being shaped by robust evidence and that actions are being taken that get us closer to realising the goals laid out in so many of our progressive policies, nationally and internationally.

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Declarations

I have no competing interests to declare. I have no AI or LLM use to declare.

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