

Chronic diseases, climate change and complexity: the hidden connections

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Abstract

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In this paper the argument is presented that we can expect an increase in chronic diseases within developing countries such as South Africa and that this is largely due to changes in lifestyle, such as diet and exercise. While these lifestyle choices are ultimately made at an individual level, they are often constrained and shaped by powerful environmental and societal forces such as globalisation, urbanisation and mechanisation.

These same changes in lifestyle are also intimately linked to increasing greenhouse gas emissions and the development of climate change. A diet more reliant on meat and refined and processed foods has a much higher carbon footprint. Reductions in physical activity are linked to increases in the use of motorised transport and further increases in greenhouse gas emissions.

The emergence of chronic diseases and climate change are therefore connected and both stem from unhealthy over-consumption of resources. The emergence of these phenomena can be understood in terms of complexity theory as properties of a complex non-linear social system. Complex systems by their very nature are unpredictable and yet share certain typical characteristics.

These characteristics of complex systems raise questions regarding how we can disturb the system to have healthier and more sustainable emergent properties. Four key areas to consider are disturbing the network, the technology, the social structures and rules and the meaning manifested in the system.

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Introduction

This paper focuses on the increasing prevalence of chronic diseases and the emerging problem of climate change. Once these two problems have been outlined, the hidden connections are explored and the paper then discusses how complexity theory may be helpful in making sense of these connections and planning a way forward.

Chronic diseases

South Africa has a quadruple burden of disease that is dominated by HIV/AIDS. Maternal and child health, as well as trauma related to interpersonal violence and road traffic accidents, make up two of the other quadrants. Increasingly, however, a fourth element in this burden of disease is that of chronic diseases such as asthma, chronic obstructive pulmonary disease (COPD), hypertension, ischaemic heart disease and diabetes.¹

In sub-Saharan Africa the prevalence of chronic diseases is expected to increase significantly over the next few years.² The number of people with diabetes, for example, is predicted to increase by 80% from 10.4 million to 18.7 million by 2025.³

In South Africa we are in the process of formulating policy and developing health services for chronic diseases. Health services that care for chronic as opposed to acute infectious diseases need to be organised differently. People need to understand their disease and be empowered to look after themselves. Adherence to medication, health education and self-care therefore become important aspects of health care. Models of primary chronic care should focus on being comprehensive, integrated, patient centred, accessible, coordinated, supportive of continuity, based on teamwork and effective leadership, evidence based, as well as family and community orientated.⁴

At present, the quality of care for chronic diseases in South Africa is generally poor due to the historic focus on acute episodic care, inequalities in human and financial resources, an inability to educate patients and a lack of appropriate organisation.^{2,5} For example, recent audits of diabetes and asthma primary care in the Western Cape showed serious deficiencies in the provision of educational materials, patient education, monitoring equipment, screening for complications and disease control.^{6,7}

Although the improvement of the quality of chronic care is one focus, this may also obscure the underlying risk factors, which are driving the epidemic of chronic diseases. The recent burden of disease study in South Africa has identified the following risk factors as particularly important¹:

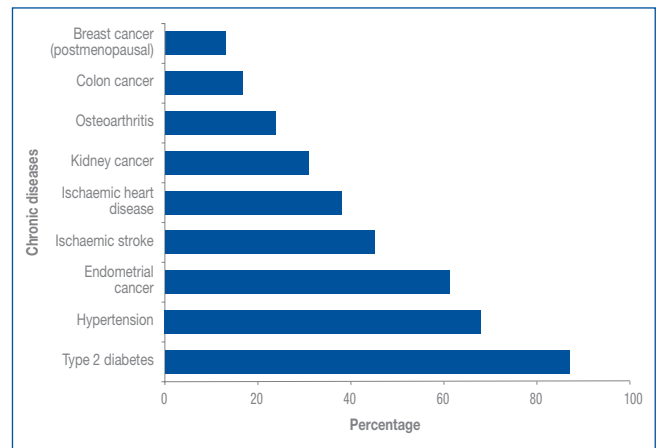
- High blood pressure
- Tobacco smoking
- Overweight and obesity
- High cholesterol
- Diabetes
- Physical inactivity
- Low intake of fruit and vegetables
- Indoor and outdoor urban air pollution

For the purposes of the argument presented in this paper only two of the risk factors, namely obesity and physical inactivity, will be discussed in more detail.

The 1998 South African Demographic and Health Survey demonstrated that South Africans already had a major problem of overweight and obesity, which co-exists in the same communities and even households with underweight.⁸ Overall, 56% of adult women and 29% of men can be classified as overweight/obese, and the mean body mass index (BMI) is 27.3 kg/m² for women and 23.4 kg/m² for men. The burden of disease study, looking at South African disability-adjusted life years (DALY), estimated the contribution of overweight and obesity to various chronic diseases (see Figure 1). The problem is greater in women and urban areas and has been linked to unhealthy diets and physical inactivity. Unhealthy diets have been characterised as high in “saturated fat, particularly of animal origin, and [with] an imbalance between the different polyunsaturated fatty acids. This diet is also very high in salt, cholesterol, alcohol, sugar and energy intake, and very low in fibre, vitamin and trace element intake.”² Daily red meat consumption in South Africa has been estimated at 126 g per person per day on average,⁹ compared to a global average of 101 g, the average in developing countries being 47 g and in developed countries 224 g.¹⁰

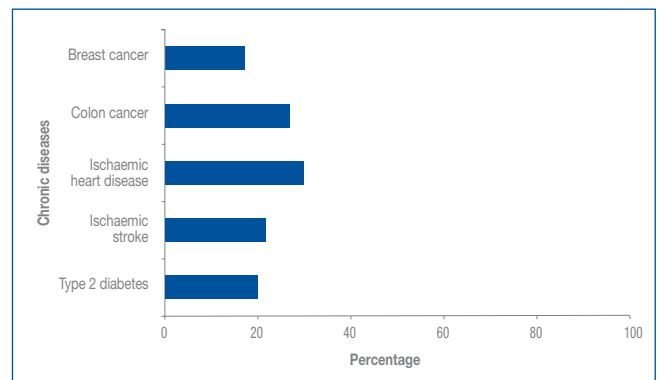
South Africa also has a particularly high prevalence of physical inactivity and the burden of disease study also shows that this significantly contributes to chronic diseases (Figure 2).¹¹ Physical inactivity is not about formal exercise,

Figure 1: Contribution of overweight/obesity to chronic disease DALYs⁸



but is defined as “doing no or very little physical activity at work, at home, for transport or in one’s discretionary time”. Overall, the 2003 World Health Survey shows that 63.2% of South African men and 75.3% of South African women are inactive or not sufficiently active (< 150 minutes/week). In terms of inactivity, South African levels of 43.4 to 48.5% compare unfavourably with the global average of 17% and the African average of 10%.¹¹

Figure 2: Contribution of physical inactivity to chronic disease DALYs¹¹



One of the key issues that these risk factors have in common is that they are related to people’s lifestyles. Choices that people make regarding eating and exercising play a critical role in the development of these chronic diseases. It is for this reason that these conditions are sometimes referred to as chronic diseases of lifestyle.

In the health sector, therefore, the management and prevention of chronic diseases focus on the need to change people’s lifestyles. Many theories of behavioural change have been developed to try to explain how people make decisions about behaviour and how health workers can influence these decisions.¹² Attention has also been given to the forms of communication and interaction most likely to help people change their behaviour. For example, motivational interviewing promotes moving from an authoritarian, directing style to a more collaborative, guiding style.¹³ Motivational interviewing has been found to

have modest benefits in reducing people's risk of chronic diseases or improving the control of those diseases.¹⁴

One unfortunate consequence of this focus on changing lifestyle is that the blame for chronic diseases is laid at the feet of individuals and is seen as a personal failing or weakness. Health workers become resentful and frustrated with patients who will just not 'assume responsibility' for their disease.⁵ Increasingly, however, it is being recognised that powerful societal forces shape and constrain the behavioural options that are available to people. The concept of an obesogenic society has emerged, which argues that we have created a social system that favours the development of obesity and chronic diseases.¹⁵ Some of the major underlying drivers of this obesogenic society have been identified as the following:

Globalisation – The development of global transnational food corporations has led to the exporting of huge amounts of cheap vegetable oil and processed foods (salt-rich snacks, sugar and soft drinks) to developing countries.^{2,16} Per capita consumption of vegetable oils and refined sugar has increased several-fold in many developing countries.¹⁰ Over the past few decades these corporations have dramatically increased the market for these products in developing countries. The demand for energy-dense processed foods leads to lower and not higher prices due to economies of scale.¹⁰ The global media have also promoted a Westernised lifestyle and have been used to market fast-food and obesogenic products to children and adolescents. In South Africa, 17% of one to nine-year-old children, as well as 7% of male and 25% of female scholars, are overweight or obese.²

Urbanisation – More people in the world now live in cities than in rural areas¹⁷ and in developing countries this has also led to the emergence of slums and informal settlements.¹⁸ Urbanisation has been associated with the adoption of more sedentary lifestyles, greater access to refined, processed and cheap unhealthy foods, tobacco smoking and less access to green spaces. At the same time, there may be reduced access to affordable whole foods, fruit and vegetables.²

Mechanisation – The increased use of motorised transport (and the desire for private cars) and the mechanisation of labour have led to reduced physical activity.²

Cultural meaning and values – Among black South African women, obesity is often seen positively as a sign of happiness, wealth, health (no HIV) and a good relationship with one's husband. Many overweight and obese South African women do not perceive themselves as having a problem.¹⁹

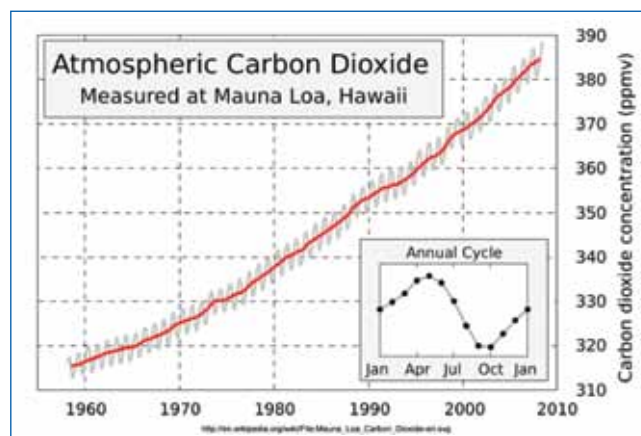
In summary, therefore, South Africa faces an increasing burden of chronic disease that is driven by a number of

behavioural risk factors, including overweight/obesity and physical inactivity. The focus of health services is on improving care for patients with established disease and on individual decisions regarding lifestyle choices. However, this focus does not adequately address the underlying drivers of the epidemic or the constraints within which individual choices are made. This paper argues that there are also hidden connections between these lifestyle choices, underlying drivers and climate change. Let us now turn to climate change and investigate these hidden connections.

Climate change

The basic concept of climate change is simple and scientifically uncontested. Solar energy from the sun warms the planet and also escapes as infrared thermal energy back into space. The rate at which infrared thermal energy is retained depends on the concentration of greenhouse gases, such as carbon dioxide, in the atmosphere. Over the past 100 years the concentration of carbon dioxide in the atmosphere has increased relentlessly and led to more thermal energy being trapped, with a consequential rise in mean global temperature (see Figure 3). The increase in carbon dioxide and other greenhouse gases over this period is attributed to the burning of fossil fuels and the loss of forests.²⁰

Figure 3: The Keeling curve showing atmospheric carbon dioxide concentrations 1960–2009



Fossil fuels such as coal, oil and gas are burnt for direct heating, to produce electricity or to produce kinetic energy in motor vehicles and aeroplanes. Although 70% of carbon dioxide emissions are due to the burning of fossil fuels, the remaining 30% are due to deforestation.²¹ Deforestation (which usually includes burning the felled trees) leads to both fewer trees to absorb carbon dioxide and direct carbon dioxide emissions from combustion.

South Africa, unlike the rest of Africa, is not innocent when it comes to our contribution to carbon dioxide emissions. We have a very energy-intensive society. On a global scale,

South Africa ranks 12th among countries contributing to carbon emissions and per capita emissions (9.8 t CO₂ per person/year) are at the same level as that of the UK, Germany and Japan.²²

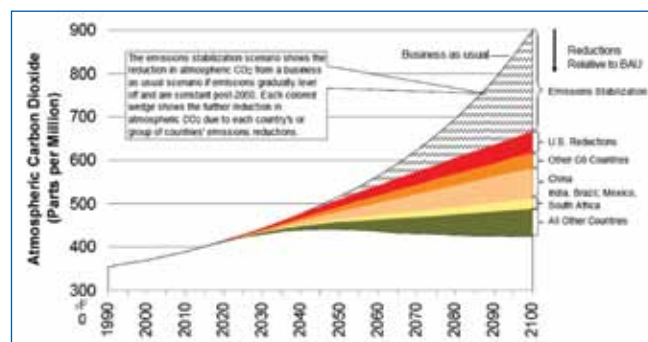
The rise in global temperature has a number of important environmental and medical consequences, some of which we are already seeing, many of which are predicted and many of which may be unpredictable. Changes that we are already seeing include the following²⁰:

- The melting of glaciers in Antarctica and Greenland, which will increase sea levels, and in the Himalayas, which will reduce fresh water supplies. Increased sea level may lead to the flooding and displacement of coastal populations. Many cities are in low-lying areas and even the City of Cape Town has predicted that there is a 80% likelihood of flooding of the city centre over the next 25 years.²³ The reduction in fresh water may increase food insecurity and threaten water supplies.
- The melting of sea ice such as at the North Pole. Sea ice reflects heat and its loss results in more heat being absorbed by the sea, with a positive feedback effect on global warming. These changes also threaten local eco-systems.
- Warmer sea water leads to more frequent and extreme storms, tornados and hurricanes and changes to ocean current systems. More frequent extreme weather events will have direct health consequences through 'natural' disasters.
- Changes in climate patterns, which means that some areas will become drier and drought ridden with more fires, while others will experience severe storms and flooding. Government has accepted the scientific reality of this problem: Martinus van Schalkwyk, previous Minister of Environmental Affairs, has stated that "global warming would make the western side of South Africa drier with a huge impact on agriculture because that's where our maize basket is. The eastern side would have longer spells of drought but heavier storms, with increased rainfall over-all, and the Western Cape would have heavier rains".²⁴ This will likewise have a direct effect on farming and food security. In Africa an additional 20 to 70 million people may live in malarious areas by 2080 and in China an additional 21 million people may be at risk of schistosomiasis. This is due to predicted changes in the natural habitat of the mosquito and snail vectors, respectively.^{25,26}

Climate change can no longer be completely avoided and attention is focused on trying to 'bend the curve' of escalating atmospheric carbon dioxide in an effort to avoid dangerous anthropogenic interference, which is expected at levels around 450 parts per million or more than a

2°C temperature increase. Some leading scientists believe that 350 parts per million is the safe long-term sustainable concentration to aim for.²⁷ Figure 4 shows that urgent reductions in emissions are required globally to achieve this goal.²⁸

Figure 4: The impact of fossil fuel CO₂ emission reductions on atmospheric carbon dioxide²⁸



The hidden connections

What then are the hidden connections between chronic diseases of lifestyle and climate change?

The agricultural sector is an overlooked contributor to greenhouse gas emissions and yet accounts for 15 to 20% of global greenhouse gases – as much as the transport industry.^{10,29} Agricultural greenhouse gases, however, are predominantly from nitrous oxide (46%) and methane (45%) rather than carbon dioxide (9%).²⁹ Methane and nitrous oxide are more potent greenhouse gases than carbon dioxide. Nitrous oxide is released from the use of synthetic fertilisers, while methane derives from ruminant livestock and manure. Livestock production, however, also contributes indirectly through deforestation for grazing land and soy-feed production.¹⁰ Worldwide, the trend is an increase in meat production, particularly in low- and middle-income countries, from 229 million tonnes in 2000 to 465 million tonnes in 2050.¹⁰ The associated increased consumption of livestock products in transitional countries such as South Africa is illustrated in Figure 5.¹⁰ Livestock production is increasing in South Africa and we are now importing soy feed to support the growing industry.¹⁰

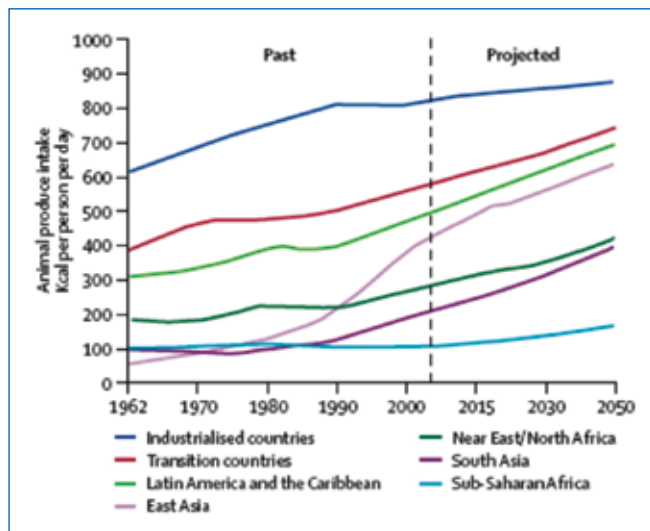
Climate change itself will have unpredictable effects on the production and availability of food. While food production may increase at high latitudes, crop yields could decrease by 50% in some African countries.¹⁰ Food security is therefore a pertinent regional issue.

The carbon footprint of the agricultural sector is compounded by the food industry and consumer choices. Food and beverage manufacturers add greenhouse gas emissions through processing, packaging and transporting food over long distances. Food retailers add additional greenhouse gas emissions through distribution and storage.

Consumers add greenhouse gas emissions depending on how they travel to shop, and how they dispose of waste and packaging. Every food product we buy therefore has a carbon footprint. A diet that is low in fruit, vegetables and plant protein but high in animal protein and fat is not only unhealthy but has a much higher carbon footprint. The impact of a diet that requires high amounts of animal protein is illustrated by the following observations²⁹:

- The amount of fossil fuel used to produce 1 kg of animal protein is 11 times higher than the amount used to produce the same amount of plant protein
- It takes 6 kg of plant protein to make 1 kg of animal protein
- Currently, 50% of the world's grain goes to feed livestock and not people
- Livestock occupy 30% of the Earth's land surface and 70% of deforested land goes to grazing

Figure 5: Predicted increases in consumption of livestock products¹⁰



To put these figures into a more dramatic form:

“If everyone in the UK stopped eating meat on one day a week, this would equate to taking 5 million cars off the road.”³⁰

“A kilogram of steak could be responsible for as many greenhouse gases as driving a car for three hours while leaving all the lights on at home.”³¹

At the same time, a sedentary, urban lifestyle, characterised by reduced physical activity, is also based on substituting fossil fuel energy for our own physical activity.³² We aspire to car ownership; passenger cars per 1 000 of the population increased by 25% between 1996 and 2006.³² In 2005, South Africa consumed 328 L of diesel and petrol per person compared to a global average of 283 L, 12 L in Ethiopia and 2 135 L in the USA.^{32,33} The increased use of motorised transport is also associated with other health

consequences, such as high rates of road traffic accidents (the fourth highest contributor to the burden of disease in South Africa¹) and significant amounts of air pollution.³² We use cars to travel even the shortest distance, when walking or cycling would allow us to meet targets for physical activity. In South African cities, collective public transport is underdeveloped and poses serious safety considerations.

It is clear, therefore, that a lifestyle characterised by unhealthy over-consumption and inactivity is not only linked to the emergence of chronic diseases, but also to global warming and climate change. For many South Africans the goal of economic development is to achieve such a lifestyle and yet if this dream were realised in Cape Town, we would need between 3 and 15 planets to sustain the use of resources required.³⁴ The goal of sustainable development therefore is to enable people to improve their quality of life in the short term while preserving the rights of future generations to do the same.³⁵ How then can we foster development that improves the quality of life for all South Africans without fuelling the epidemic of chronic diseases and contributing to an unsustainable planetary future?

The final section of this paper investigates whether viewing the problem through the conceptual lens of complexity theory can help us to see a way forward.

Complexity

Complexity theory has become a new way of making sense of interconnected and unpredictable systems. Can complexity theory help us to make sense of the connections between chronic diseases, climate change and the forces shaping them both?

Complexity is not a monolithic theory and includes at least two broad camps,³⁶ namely mathematical and philosophical. This paper draws on the more philosophical perspective of Capra, who analyses the characteristics of living systems and concludes that they can be understood as non-linear complex systems. He shows the parallels in understanding between biological and social complex systems.³⁷

Capra summarises the characteristics of complex non-linear systems from four interrelated perspectives: form, matter, process and meaning (see Table I). All of these elements are constantly in a dynamic process of interaction, change and renewal. Although biological and social complex systems share many of the same characteristics, the reflective consciousness of people in social systems adds an additional dimension of meaning. The people in a social system share meaning that is based on underlying values and beliefs and which is manifested in the social structures, cultural boundaries and interaction with the environment.

If we assume that chronic diseases and climate change are unhelpful emergent phenomena of a complex system, this

Table I: Comparing the features of biological and social complex systems³⁷

	Biological (cellular) systems	Social systems
Form/pattern of organisation	Networks – components linked by multiple connections and feedback loops	Networks – people linked by multiple connections and feedback loops
Matter/structure	Structural cellular components	Technology (roads, power stations, houses)
	Cellular components involved in energy transfer/exchange	Material goods (food, products, cars) involved in energy transfer/exchange
	Genetic components	Knowledge (art, books, digital)
	Physical structure (biochemical and physical laws)	Social structure (rules of behaviour, power relations, e.g. hierarchy, organograms)
	Cell membrane/boundary – organisationally closed but energetically open	Culture – belonging and identity defined by shared meaning and beliefs
Process	Chemical reactions	Communication
	Continually self-generating (autopoietic)	Continually self-generating (autopoietic)
	Emergence of new properties	Emergence of new activities/behaviours
	Interaction with the chemical environment – leads to self-directed adaptive changes	Interaction with the social environment/circumstances – leads to self-directed adaptive changes; effects dependent on what is interpreted as meaningful
Meaning		Depends on reflective consciousness / inner world. Shared and embodied values, beliefs, purpose

leads to the question of how we can change this system for the better.

Capra asserts that one can only plan to disturb a complex system, which always remains to some extent unpredictable. Nevertheless, Capra's parallels between biological and social systems highlight a number of ways in which we can attempt to disturb the social system in order to avoid catastrophe, namely

- changing who is connected in the network;
- changing our technology;
- changing the social structures of power and the rules of the game; and
- changing what is seen as meaningful – values, beliefs, purpose.

A number of examples and implications of this can be seen in our contemporary society.

Changing who is connected in the network: The development of the internet has allowed people and organisations who share similar values and goals, but who are geographically separated, to network. From these new connections have emerged new activities such as the protests seen at the World Trade Organization, Seattle, in 1999. Diverse groups of “human rights activists, labour activists, indigenous people, people of faith, steel workers and farmers” were self-coordinated by a network of cell phones, emails and the internet.³⁷ More locally, the development of interdisciplinary research that links people from different faculties in a university may also lead to the emergence of new insights and activities.

Changing our technology: Although new technology that is currently available would allow us to ‘bend the curve’²⁹ of greenhouse gas emissions significantly, the mere existence of technology does not seem to be sufficient to ensure widespread implementation without a shift in how the social system perceives the value of this technology. Nevertheless, technology such as electric cars, thin-film photovoltaic cells, cost-saving energy-efficiency measures and fossil fuel energy replacements such as wind, solar and hydro energy are available.³⁸

Changing the social structures and rules: Health systems can testify that changing the rules is often a powerful tool for change. For example, a 10% increase in the price of cigarettes causes a decrease in smoking prevalence of 4% in adults and 6% in children.³⁹ Nevertheless, such changes in the rules within the social structure require changes in the consciousness of the leadership. Social system change that relies on a value-driven approach has been described by Richard Barrett and identifies that the personal transformation of leaders within the system is a key driver of change, together with the more conscious alignment of values with behavioural and social structures at both a personal and collective level.⁴⁰ World leaders met late last year in Copenhagen to discuss the need for new rules and regulations regarding greenhouse gases and climate change.

Changing what is seen as meaningful: Ultimately, this author argues that the greatest driver of change affecting who is connected, who is included, what they engage with

and what rules they enforce is what the people within the system consider meaningful. The Alternative World Health Report critiques the values and beliefs in the current model of development and makes three key observations.¹⁶ The current model focuses on economic growth and “equates total income with well-being” while ignoring the gross inequalities within and between countries. The report argues for a system that includes social values such as the “eradication of poverty and the right to health”. The second critique is of the “reliance on increasing exports as a source of economic growth, and the requirement for global consumption to grow in order to absorb these extra exports”. There are environmental limits to the extent to which increased consumption can be sustained, and climate change would be one indicator that these limits are imminent. Their third critique is that the model is based on the value of competition, whereby countries must compete for a share of the market in the same way that companies do. However, “unlike an uncompetitive company, a country cannot cease to exist”. The losers are therefore trapped in a downward spiral. According to the report, “the growing number of failed countries in sub-Saharan Africa might thus be seen not as an unfortunate accident, but as an inevitable consequence of the competitive nature of neoliberalisation”. It would seem, therefore, that we have a social system that finds meaning in the values of competition, unsustainable consumption and socially unresponsive economic growth. The question this leaves us with is whether these values and beliefs are the ones that will enable us to create a sustainable future?

Conclusion

In this paper the argument is presented that we can expect an increase in chronic diseases within developing countries such as South Africa and that this is largely due to changes in lifestyle, such as diet and exercise. While these lifestyle choices are ultimately made at an individual level, they are often constrained and shaped by powerful environmental and societal forces such as globalisation, urbanisation and mechanisation.

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Declaration

This paper is based on an inaugural speech by Professor Bob Mash at Stellenbosch University in November 2009.

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