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ORIGINAL PAPER

Reconsidering development by reflecting on climate change

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Abstract Reconsidering development by reflecting on climate change means rethinking development goals, more than pursuing climate targets. Much analysis in the development–climate literature has framed development as a co-benefit, while the objective has been climate stabilization. This misses the point that development drives emissions, not vice versa. A different approach must address low-emission technologies, but also the high-emission parts of 'development'. Politically, climate change must be understood as a development problem. In this conception, a key task for climate policy is to explore different development paths, with the difference in emissions being a result. Development goals need to be represented as explicit objectives, both in analytical modelling and as political goals. Methods that treat climate policy as a self-control mechanism in the development system, or back-cast from development goals, need to be improved. The article further considers levers to change development paths, considering lessons on how to influence change in complex systems. The obsession of the existing economic order is with economic growth and development; what needs to be considered is the *quality* of development and what it means to live well. A social contract for low-carbon development requires the rich to pay for mitigation, use less, and assist the poor; lift the poor out of poverty; and change the aspirations of the middle class. Such a contract requires thinking beyond short-term political and economic time frames, with much longer-term thinking and vision.

Keywords Development · Climate change · Theory of change · Poverty · Social contract

Abbreviations

BEET	Balance of embodied emissions from trade
CTL	Coal-to-liquids

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GCMs	Global circulation models
GDP	Gross domestic product
GHGs	Greenhouse gases
IAM	Integrated assessment models
IDEAM	Instituto de Hidrología, Meteorología y Estudios Ambientales
LTMS	Long-Term Mitigation Scenarios
MAPS	Mitigation Action Plans and Scenarios
MCGs	Millennium Consumption Goals
MDGs	Millennium Development Goals
NDP	National Development Plan
RCPs	Representative Concentration Pathways
SRES	Special Report on Emissions Scenarios
SSPs	Shared Socio-economic Pathways
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

Climate change is a deeply economic and social problem. Emissions of greenhouse gases (GHGs) are integrally bound up with development paths. At least since the Intergovernmental Panel on Climate Change (IPCC 2000) published a Special Report on Emissions Scenarios (SRES), we have known that the difference between development paths matters at least as much as climate policy.

Yet the predominant approaches to both analysis and action to prevent climate change remain climate first. Many use a shorthand for the objective of the United Nations Framework Convention on Climate Change (UNFCCC) as 'climate stabilization', or more precisely, stabilization of GHG concentrations, as a proxy for climate. Less attention is given to the second sentence of UNFCCC Article 2, which conditions the achievement on making development more sustainable (Munasinghe 2007).

From our perspective, 'climate first' or 'development first' approaches do not necessarily, nor exclusively, refer to the sequence of planning, but to a different understanding of the interdependency of climate change and development, and potential effectiveness of climate mitigation policy. In this regard, two important considerations are needed to address the deeply interdependent challenges of development and climate change. The first one is that, in developing countries, climate action must be done in a way that at a minimum does not increase poverty and inequality. One might also identify a third, 'climate only' approach, which would in our view have no traction in developing countries. Ideally, mitigation should contribute to addressing poverty and developmental deficits, as acknowledged in key international environmental agreements, including the Rio declaration (UNCED 1992) and in the UNFCCC (1992). The second is to take full account of the socio-economic implications of mitigation actions and adaptation. The implications for employment, education, mobility, housing, and many other aspects ought to be included in assessments.

The first challenge requires the development of a better understanding of the emissions associated with different development paths. Tools in this regard are not well developed (particularly for longer-term analysis) and should not stop at analysis but enable action. For example, integrated assessment models (IAMs) are focused on 'stabilization scenarios' and

struggle to represent developmental goals, taking growth in gross domestic product (GDP) as given, without explicitly representing its content. Tools for such analysis are improving, including in the Mitigation Action Plans and Scenarios (MAPS) community (e.g. La Rovere et al. 2011) but are not yet mainstreamed in the integrated assessment modelling (IAM) community (Shukla 2013).

If development becomes the main variable to account for, and influence, GHG emission trends, we urgently need to consider how development paths might be changed by a complex set of actions—most of which are not usually thought of as climate policy. A greater understanding of national development goals and strategies, and of how to achieve such goals is needed across all of economy and society. Mitigation analysis is needed not just of areas of the economy, but with a full understanding of the whole economy, its complex set of interlinkages, and the effects of developmental choices across sectors and classes. Choices about development paths are not marginal (Stern 2009). Addressing the consumption patterns in developed countries, but also more generally for the emerging middle class across all countries, is crucial. It will require, in policy terms, a new social contract (see Sect. 5.4).

This article explores an approach that reconsiders development by reflecting on climate change. By 'reflection', we mean a process of careful consideration. It seeks to theorize more fully the relationship between development and climate, building on the literature that has emerged in this field (Banuri and Weyant 2001; Baumert and Winkler 2005; Davidson et al. 2003; Halsnaes and Shukla 2005; Moreira et al. 2005; Najam et al. 2003; Sathaye et al. 2007; Shukla 2006; Winkler et al. 2002, 2008; Wlokas et al. 2012). It seeks to explore the linkages between the economy, the developmental aspirations of people across society, and the need to limit climate change. We are grappling with the challenge through a programme known as MAPS. This paper illustrates the conceptual points with examples from MAPS practitioners engaging on development plans in their countries.

Section 2 discusses climate first or development first approaches, Sect. 3 explores approaching the challenge from the perspective of different development paths, leading to differences in emissions, Sect. 4 examines the drivers of development, and Sect. 5 focuses on how to change development paths.

2 Beyond climate first and development first

Approaches may be climate first or development first. The climate first approach faces challenges. While it starts from robust science (IPCC 2013), it is seen as being 'unrealistic'. Concern about climate change, despite lip service to its gravity, takes a distant second place to economic concerns, especially in times of financial crisis in the North and in the context of poverty and inequality in the South. Climate first has limited uptake among leaders in the political economy, politicians, or captains of industry—and a fortiori in developing country contexts.

The methodological approach usually relies on a counterfactual scenario or baseline, the analysis of reductions against this baseline, incremental costs, and—sometimes—the future costs of inaction. It remains peripheral to the economy itself: mitigation actions remain projects at the fringes of the economy, are tested in cost–benefit terms, and remain small adjuncts to the emissions-intensive, 'real' economy. Furthermore, the modelling approach precludes the possibility of multiple benefits (discussed further below). This distracts from

what should arguably be the primary question: How can the entire economy become low carbon, with net benefits?

What might lie in between a scenario of inadequate, fragmented action, and one that involves massive redirection of the entire economy? Possibly, the focus should be on near-term actions that are able to transform the economy. This would include anticipating where key decision points or bifurcations in the economy are about to occur (e.g. with decisions to invest in long-lived infrastructure or planning of urban form). Yet an agenda of 'transformational change' might lead to carbon colonialism, if the demand for 'transformation' is imposed by Northern donors on Southern countries (Dubash 2012; ODI 2013). But, transformation can be positive, *if* it is rooted in the developmental aspirations of the economy and society in which it takes place. Who defines transformation matters deeply when pursuing 'transformational change'.

In contrast, the 'development first approach' (Davidson et al. 2003; Jiang et al. 2007; La Rovere et al. 2007; Shukla et al. 2007; Winkler et al. 2007) would embody the realization that 'the business of society must be founded on a new "business basis"'(WBGU 2011: 2), and will consider how the economy currently works, how it should develop, and how that will be sustainable on all levels in the future (Banuri and Weyant 2001; Sathaye et al. 2007).

The scale of this transition is to be measured against the climate objective: if restricting global warming to a mean temperature change of 2 °C is to succeed with a probability of at least two-thirds, then, by the middle of this century, no more than around 750 Gt of CO_2 from fossil sources may still be released into the atmosphere (Stocker et al. 2013). At today's emission levels, this global CO_2 budget would already be exhausted in about 25 years. We therefore need fast, transformative counteraction. By the middle of the century, the global energy systems must largely be decarbonized and deforestation must be largely halted (WBGU 2011), with forestry and energy treated as integral parts of the larger economy and society.

We are not proposing a development-mitigation approach to replace more mitigation-focused approaches, nor as a substitute for analysis of the socio-economic implications of mitigation. Development and climate should be understood in both directions. But there appears to be less work on changing development paths to meet policy goals and seeing differences of emissions as a co-benefit.

3 Different development paths lead to different levels of emissions

The emissions of alternative development paths differ dramatically. Figure 1 illustrates the differences between the Special Report on Emissions Scenarios (SRES) families from a developmental perspective, with the shaded scenarios being reference scenarios without climate policy. This is not exactly the same as scenarios of development, but makes a compelling case that considerations other than climate policy matter. However, there is no detailed representation of development paths or of the composition of GDP in particular countries. If the world were to follow an A1FI (fossil-intensive) scenario, based on all the assumptions made about drivers input to the models, then there is a large gap between where emissions are going in the future, and stabilization at any level between 750 and 450 ppmv (parts of CO_2-eq per million by volume, a measure of concentration of GHGs). If the world were to evolve along a more sustainable storyline as in the B1 family of

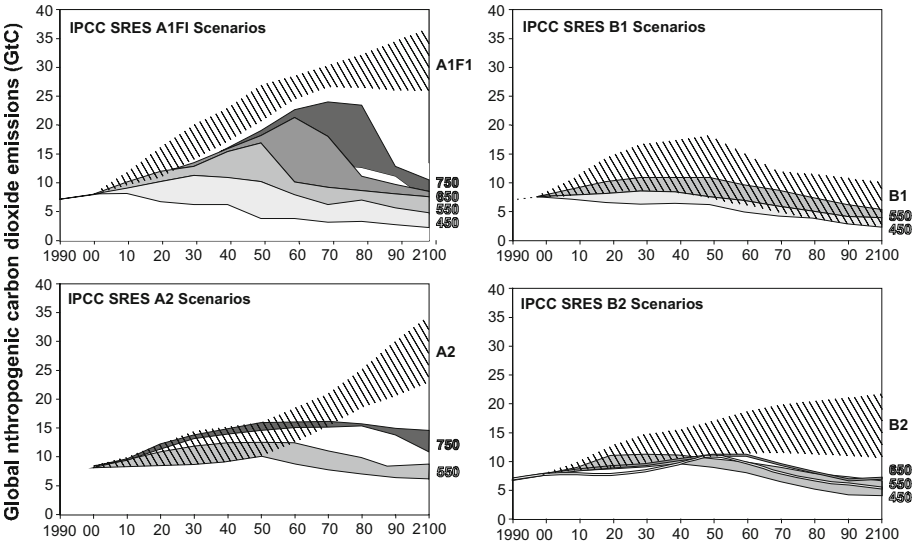

Fig. 1 Different scenarios without climate policy show widely differing emission projections. *Source*: adapted from Figure 2.14 of (IPCC 2001)

scenarios of the Intergovernmental Panel on Climate Change, there is already a significant overlap with stabilization at 550 and 450 ppmv.

Analytically, the challenge is to develop similar global scenarios, but rather than only ones with a goal of climate stabilization (e.g. at 2 °C above pre-industrial levels, or 400 ppmv), scenarios that explicitly model different development paths. The goal of different development paths might include economic growth (as measured in GDP), but also include the quality of life in education, literacy, other quantitative metrics—or indeed the quality of 'living well'. Structural change that is required to change patterns of consumption and production needs to be represented explicitly (Box 1).

Part of the challenge lies in the mindset of using models, deriving a reference case (also called baseline or business-as-usual), on which a carbon constraint is imposed, or mitigation actions implemented to reduce GHG emissions relative to the reference case. This approach does not challenge the 'engine of growth', as GDP growth is an assumed driver.

Box 1 Long-Term Mitigation Scenarios for South Africa

The challenge represented by the SRES globally also applies in national scenarios for low-carbon development. Long-Term Mitigation Scenarios (LTMS) for South Africa (SBT 2007) were based on technical analysis with key drivers that included GDP, population projections, discount rate, technology learning, exchange rate forecasting, future energy prices, and emission factors (Winkler 2007, 2010). The scenarios were co-produced by a Scenario Building Team in a facilitated stakeholder process (Raubenheimer 2007) mandated by Cabinet. When the technical results and discussions among stakeholders over 2 years had been completed, many options had been examined, combined into packages of actions, and the socio-economic implications assessed (Kearney 2008; Pauw 2007). Yet a gap remained between the reference case of 'Growth without Constraints' (Winkler et al. 2011) and what was considered 'Required by Science'. The LTMS identified areas not fully explored—behavioural change, new resources, as yet unknown technology and, perhaps most fundamentally, deeper changes in economic and industrial structure (SBT 2007)

The reference case is considered optimal, in the sense of being least-cost. It also assumes that the economy is already at its 'production possibility frontier' (Nicholson 1995), thus requiring a trade-off between development and mitigation. If the economy is not assumed to be optimal, then the possibility of achieving multiple objectives at the same time exists.

Development should not only be considered as an input to modelling the 'reference case', but also fundamentally a policy goal—including climate policy. IAMs currently focus overwhelmingly on scenarios of climate stabilization—and clearly such work needs to continue. But the 'data spine' of international assessment of climate change must be developed to model different development paths and provide information on which levers might shift development in a more sustainable direction.

In terms of political economy, the challenge is to consider levers of change that solve a range of developmental problems such as public debt, growing inequality, resource depletion, climate change impacts, and adaptation, in such a way that fossil dependency is rapidly eradicated from the economy, driven by the redesigned development pathway. The challenge is how to actually achieve shifts as in the example above. Before turning to levers of such change, we consider what drives development.

4 What drives development?

Making assumptions about future drivers implicitly defines development. Analysis of mitigation often starts with drivers of development. The SRES families of scenarios had storylines that were defined around assumed future trends in population, economy, environment, equity, technology, and degree of globalization (IPCC 2000). Note that these include economic growth as one key driver, even a major one, but that other aspects are included too (Fig. 2).

The SRES are now more than a decade old, and new scenarios are being developed. Climate modellers (those running global circulation models, GCMs) have developed Representative Concentration Pathways (RCPs). RCPs are defined directly around the change in 2100 radiative forcing in W m^{-2} (Van Vuuren et al. 2011): they focus on the direct increase in energy reaching the Earth, not atmospheric concentrations of GHGs or emissions. The climate research community is developing Shared Socio-economic Pathways (SSPs), (Arnell et al. 2011), which include all the drivers found in the SRES approach, and more—equity is more broadly framed in relation to societal factors such as welfare, resources, institutions, and governance, and somewhat controversially (given that these are socio-economic pathways) even climate mitigation policies are added to the six SRES drivers. Each of these can be further broken down (see a longer list in Arnell et al. 2011: 24–25).

The SRES drivers are useful, but limited. First, they mix some parameters that we would consider development drivers—e.g. economic growth (typically using GDP projections) and population growth. Other input parameters, for example equity or globalization, may say more about the quality of global development. It is not only the sum of the projections of the individual parameters as in stabilization scenarios at the global level that is of interest, but also the interaction between these forces and their understanding. The drivers are treated as independent parameters, which they are not in reality. They are presented without clearly distinguishing those that are explicit about ethical judgements (equity) from others where such implications may be implicit. The drivers reflect overserved trends, or projections—rather than a deeper understanding of how the drivers

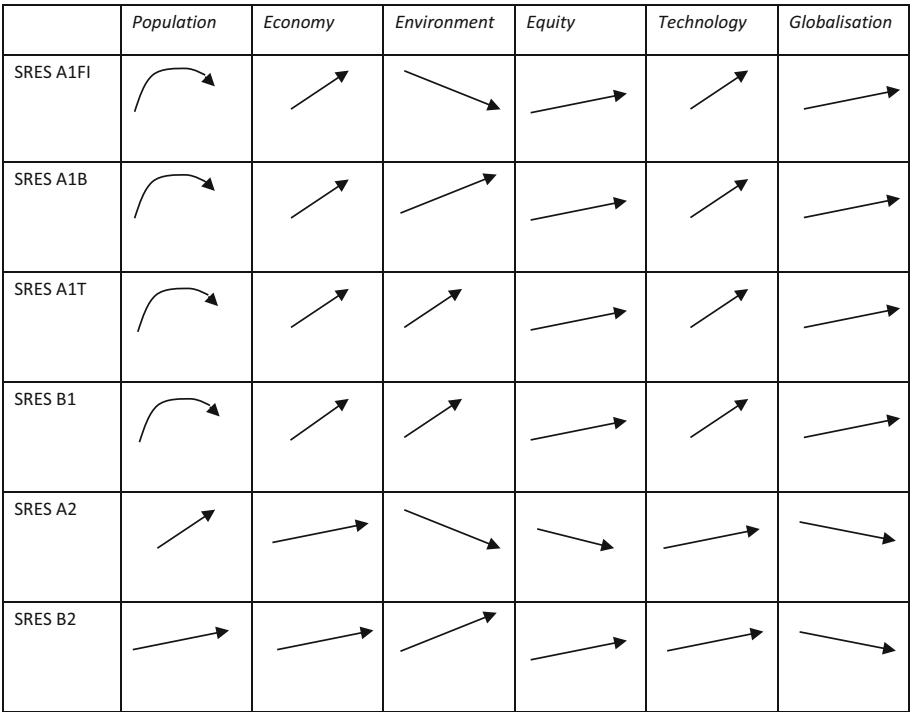

Fig. 2 Graphic representation of drivers in IPCC SRES. *Source*: adapted from Figure TS.1 of (IPCC 2001)

interact with human behaviour. One might ask in what sense might environment, and specifically climate, be a driver of development? However, even such an approach still frames the drivers purely as inputs to modelling.

The useful work on developing SSPs for the climate research community takes a step forward (Arnell et al. 2011), but omits the policy choices available to governments on key development directions. Analytically, what is needed is modelling of development paths, not achieved in the RCP/SSP literature yet. The SSP framework seeks to connect climate (radiative forcing), development (socio-economic reference pathway), and the policy context.

Development, however, remains a reference pathway. In the practice of modelling, development 'drivers' are inputs to models, and the development path is considered the 'reference' or sometimes 'business-as-usual' path. Modellers do not claim that these pathways are likely evolutions of the real economy, but use the projections as a reference against which to assess policy interventions. In most cases, only a single development path is considered, rather than alternative ones. More fundamentally, development is treated as an input to model a climate objective, rather than defining the objective of modelling, indeed, being included in its objective function. If development, including more sustainable or climate-compatible development, is defined as reference, this is not designed to produce information on how to change development paths, or how irreversible some choices at points of bifurcation may be. This gap has persisted for several decades and urgently needs to be bridged.

Box 2 How do *locomotoras* (pillars) of development relate to low-carbon futures in Colombia?

Policy goals, in particular, development-related ones, were the starting point at the strategic discussions about framing and understanding mitigation in the medium and long term in Colombia. Their sustained growth has increased their GHG emissions. Based on inventory data from Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM)[a], the average annual growth rate in the period 1990–2004 was 1.98 % (Cadena Monroy et al. 2011). A climate first analysis considered the current GHG inventory as an initial basis to assess mitigation potential. The Colombian case illustrated a developmentally focused approach, looking at the National Development Plan (NDP). In the NDP, the government states what the fundamental pillars (*locomotoras*) for economic development for 2014 will be. They are strongly related to GHG emissions, and therefore, it is plausible to assume that GHG emissions will increase with the implementation of the NDP. The NDP states that the *locomotoras* are sectors that have an accelerated growth rate in comparison with other sectors: mining and energy, housing, transport infrastructure, and agriculture. The last two are developing slower than their potential; hence, their development will be promoted (Cadena Monroy et al. 2011). The challenge in Colombia is not only how to develop niche 'green' sectors, but also how the *locomotoras* relate to the transition to a low-carbon development path

[a] In English: Institute of Hydrology, Meteorology and Environmental Studies of Colombia

Climate-economic studies typically put 'policy decisions about how to balance emissions reductions with climate damages in the framework of economic growth theory. In this framework, the economies of the world begin with reference paths for consumption, capital, population, emissions, climate, and so on. Policies change the trajectory of emissions, greenhouse gas concentrations, impacts, and consumption. Alternative paths of climate policies and consumption are then evaluated using a social-welfare function that ranks different paths' (Nordhaus 2007: 690).

Developments in the economics of climate change have taken us some steps in this direction. The Stern Review considered both the costs of action (mitigation and adaptation) and inaction (impacts) (Stern Review 2006). This puts issues of economic growth more centrally in focus, but does not reflect the content of development, its drivers, or the levers that may change the overall path of socio-economic development in detail. The example of Colombia (see Box 2) offers some further ideas.

In many African countries, the priority on climate change is on adaptation, which also implies avoiding high emissions—which brings us back to the nature of the development path. A more resilient development path is one that would have greater adaptive capacity, hence a better response to climate impacts—and be more robust to a carbon constrained future. Rwanda, for example, has adopted a *Green Growth and Climate Resilience Strategy* (Rwanda 2011) indicating its priorities.

Policy makers are more interested in the implications for development, than input parameters of models and a better understanding of the levers to change development paths.

5 How to change development paths?

Taking a step back, if the argument is that development needs to be considered as a policy goal, then we should consider how we believe change happens. How might a development path be changed? Much of the literature implicitly assumes that change occurs in a deterministic fashion. Adopting policy x will lead to result y; technology a replaces technology b; investment shifts from a high-carbon to a green portfolio. While policy,

investment, and technology remain critical factors, it seems readily apparent that development is not a linear process. While there may be discontinuities in technological development, it would not seem prudent to rely on breakthrough technologies alone to save the day. What is particularly deterministic are projections of economic growth along a smooth upward path. Not only does this not match experience, it ignores the requirements of changes in economic structure and behaviour.

5.1 Levers to change complex systems and places to intervene

But is it possible to change development paths? Is it possible for an agent or a country to deliberately change its development path? Or is the development path a function of myriad of decisions by multiple actors across many scales and institutional settings? Are prices sufficient to signal required changes, or are other interventions also needed (Sathaye et al. 2007)?

The conceptual shift required is to consider change by means of multiple levers of change to influence complex multiple systems, sectoral challenges (e.g. energy), scalar issues (from international to local), with multiple actors (government, business, and civil society).

There is a long tradition of the study of complexity and approaches to systems theory (see von Bertalanffy 1968). Meadows (1999: 2) suggests nine 'places to intervene in a system (in increasing order of effectiveness)': 9. Numbers (subsidies, taxes, standards); 8. Material stocks and flows; 7. Regulating negative feedback loops; 6. Driving positive-feedback loops; 5. Information flows; 4. The rules of the system (incentives, punishment, constraints); 3. The power of self-organization; 2. The goals of the system; 1. The mindset or paradigm out of which the goals, rules, feedback structure arise.

The hierarchy of these levers of change moves from technical to cultural. These levers within various development paths need further elaboration in order to consider their scale and effect, generally and on emissions. Meadows' scheme suggests that subsidies and taxes, as well as material flows within the system, rank much less effectively as levers of change than the rules of the system, the goals of the system (such as perpetual GDP growth, or high return on investment), and finally the power to change those rules/goals. This is not to say that the bigger changes are easily achieved, nor that changes at 'lower' places—e.g. pricing carbon might be an example of a 'tax' under Meadows number 9. This is an important near-term intervention, but should not lead to the assumption that we have sufficiently changed the larger system. This would be the case if taxes are levelled at the margins of the system, and economic theory is predisposed to consider marginal changes. In theory, much higher taxes might be levied, leading to structural transformation—this could be viewed as a change in the 'rules' of marginal adjustment to the economy. It is likely that such deeper changes are possible over longer times, and their relationship to near-term marginal changes bears further examination.

Meadows also talks to the power of paradigm shifts and advocates working with active change agents to identify failures of the old paradigm rather than wasting energy on the reactionaries. This approach is being explored through the MAPS collaboration where active change agents within countries have been identified to develop an evidence base that can shift the current approach to development towards an approach, which considers the implications/benefits of long-term planning, and the broader socio-economic implications of development paths. This consideration, while abstract, is a call to depart from maximizing utility in ways that can be represented in smooth functions. It considers how to

influence the practice of development, understanding the complexity of the process, and its relation to emissions.

5.2 Development as practice and climate as reflection on development

These considerations lead us to think of development as practice and climate as a reflection of development. Figure 3 shows a conceptual approach that starts from action in the developmental space and reflects on development from a climate perspective, in order to change the quality of development. With further experience of development, further reflection follows, and the pattern of action–reflection–action is repeated (Freire 1970)—or in this case development–climate–development. Figure 3 illustrates this iterative process. While it might seem to be moving forward only, the multiple iterations are intended to convey that interactions can move backwards as well as forwards.

This needs further unpacking. Development is conceived as the practice, and its goals, such as providing villages with access to potable drinking water, improved food security, energy security, or reducing poverty levels, enhance adaptive capacity (Box 3).

On the other hand, is development the best strategy for climate stabilization? Can extreme poverty and hunger be eradicated without increasing GHG emissions? Can middle-income households shift to consumption patterns from high-income households without an effect on emissions? Does an iterative reflection on development enables the prior two questions to be addressed in the policy arena? The answers are not straightforward, and in short, one could say it depends. It depends on the development path as seen above.

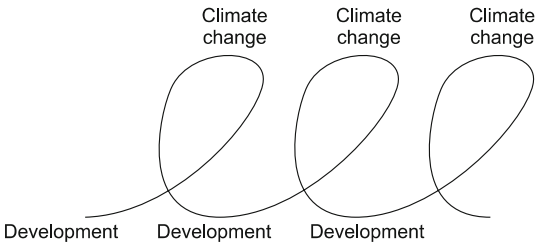

Fig. 3 Iterations of action and reflection on action, as development–climate–development. *Source*: own diagram, drawing on Freirean pedagogy

Box 3 Energy security and climate change

What might this iteration of development and climate looks like? Consider energy security and climate change. Physical infrastructure such as large coal-fired power plants influences the energy mix, yet changing this is not simple. Following Meadows, one might suggest that proper design is needed in the first place focusing on the system goal. Taking this idea further—what if the system goal is to achieve the development objective of 'energy security' in order to target GDP growth? Investments into cheap (and dirty) power could lead to more manufacturing, more GDP from exports, more wealth, more consumption and essentially result in higher emissions. This exponential effect is described as a positive-feedback loop, where no measures are in place that self-control the system. According to Meadows, un-controlled positive feedbacks are dangerous in complex systems and must be slowed. Could mitigation act as a self-control measure? Using the above example, if 'energy security' is the goal, step back and ask first why is energy security needed (the answer might be to deliver jobs, housing, and self-reliance), and second how could this be achieved in the most climate-compatible way. If a development path is chosen that does not fulfil certain climate requirements, it should be reconsidered. It is not trying to re-define a development goal, but consider how to achieve it using the lens of mitigation as a self-control mechanism in the system

5.3 Changing patterns of consumption and production

Ultimately, GHG emissions relate fundamentally to patterns of consumption and production which are key pillars of economic growth and development. Yet current patterns go beyond the capacity of the planet. The global economy already uses natural resources equivalent to almost 1.5 planets earth, with the world's richest 1.4 billion consuming almost 85 % of global output, which is over 60-fold the consumption of the poorest 1.4 billion (Munasinghe 2012). The underlying paradigm is one of economic growth centred on rapid accumulation of physical, financial, and human capital, while excessively depleting and degrading natural capital (including natural resources, ecosystems, and biodiversity). Addressing patterns of consumption and production is therefore crucial to unpack development paths.

An important implication of the consumption-based approach would be accounting. As the cases from Spain and China in Box 4 make clear, it matters whether emissions are attributed to producers or consumers.

The choice of modes of production remains important to meet development goals. The Chinese twelfth five-year plan aims to accelerate the reform of energy production and utilization mode: through conservation first, diversified development based on domestic resources and environmental protection (China 2011). The plan foresees an increase in the share of non-fossil fuel energy in the primary energy mix (from 8.3 % in 2010 to 11.4 % in 2015) and decrease in the energy and emission intensity of the economy (China 2011), thereby balancing growth with social well-being and environmental sustainability (TCG 2011). However, when considering the priorities of energy construction in China, they are listed in the following order of priorities: coal development and transformation, stabilizing oil output, and increasing gas output, nuclear power only then followed by renewable energy sources (China 2011).

The plan also addresses the transport sector, where the desire to reduce energy intensity is at odds with the aim to provide mobility, by means of domestic liquid fuel supply. The expansion of coal-to-liquids (CTL) production is part of the effort to expand the local

Box 4 Analysis of emissions associated with consumption and production in Spain and China

A study analysing Spain's carbon footprint by Regional Activity Centre for Cleaner Production (CP/RAC 2008) points to a growing carbon footprint due to increased imported GHG emissions, i.e. emissions associated with the production of imported goods and services. GHG emissions per capita from 2000 to 2005 grew by 5 % if we only look at production and by 14 % if account for consumption. Improving life standards in industrialized countries is coupled to growing emissions

It contrasts this with China, now with the highest GHG emissions per year—in absolute terms, though not per capita nor historically. In absolute annual terms, analysis suggests that 23 % of China's national emissions in 2004 could be attributed to goods exported by China to other countries (Wang and Watson 2008). Peters and Hertwich (2008) find a similar ratio of emissions embodied in exports (24.4 %), but also calculate the share in imports (6.6 %), leaving a 'balance of embodied emissions from trade' (BEET) of 17.8 % for China, that is China's exports contain more carbon than its imports

This is part of a broader pattern shown by Peters and Hertwich: globally, there are over 5.3 Gt of CO_2 embodied in trade and developed countries are net importers[a] of CO_2 emissions and non-Annex B countries are exporters (Peters and Hertwich 2008). This implies that by adopting a more consistent measure of GHG emissions based on consumption, the respective responsibilities of developed and developing countries would be shifted

[a] The BEET for developed countries in Annex B is −5.6 %, that is net emissions are associated with imported goods, whereas for non-Annex B, it is 8.1 %, that is net export of emissions (Peters and Hertwich 2008)

market. From the South African experience with CTL plants, Sasol's Secunda plant with a capacity of 150,000 barrels per day has GHG emissions of 71 Mt CO_2-eq per year (CDP 2010). If several such plants were built to improve mobility for the Chinese population, there would be increased emissions in the hundreds of megatons per year. It is implausible to suggest that China will abandon the developmental goal of providing mobility. However, achieving this through increased CTL rather than expanding the public transport infrastructure, will inevitably have different implications on emissions. It might be that other means than CTL are needed to produce fuel—which raises concerns about domestic supply and energy security. These supply-side options need to be complemented with demand-side options, including greater efficiency and patterns of consumption (although they are not an easy lever to move).

To what extent are GHG emissions a problem of consumption—and who are the consumers? The short answer is that it is about the affluent part of the population. The changing inequalities across and within countries (Winkler and Rajamani 2014) show that there is a continuum of countries along indicators such as income, but they are yet to reach the same point. Despite advances in emerging economies, these countries are not in the same position as developed countries. Milanovic (1999, 2006, 2008, 2012) shows that incomes diverge widely across the world. There is a spectrum in each country, but America's poorest 5 % are, as a group, about as rich as India's richest 5 %. So while averages can obscure differences, including inequalities within countries, the remaining international inequalities must be borne in mind.

Income inequality exists within countries—in South Africa, for instance, inequality as measured by cumulative income against cumulative population is particularly high, with a Gini coefficient of 65 %. These inequalities are not the appropriate subject of negotiations in the context of a climate treaty applicable to nation states (Winkler and Rajamani 2014).

They are relevant to consideration of which classes are most important in acting on climate change at a national level. The global middle and upper classes are the 'billion high emitters' (Chakravarty et al. 2009). Whether the development path of these classes in emerging economies mimics the development pattern of North Americans, or Europeans, or follows its own path, will be critical to global emissions. And, the history of colonialism and underdevelopment that made the North 'developed' cannot be ignored.

5.4 A social contract on changing patterns of consumption and emissions

We thus need a social contract that would make radical changes to patterns of over- and underconsumption (see Fig. 4).

The poor need to be lifted out of poverty, with little increase in emissions (though where possible, they should avoid repeating the past mistakes of rich). A shift of those below the 'wash-line' (in Rosling's terms) to have a washing machine does not put the climate at risk.

Hans Rosling points out that the one billion individuals living in the modern industrial areas of the North consume about as much energy as the remaining six billion people (Rosling 2010; Kanellos 2011). Development in terms of lifting the poor out of poverty does not lead to a significant increase as in South Africa (Tait and Winkler 2012). However, in India, given the scale of poverty, an inclusive development strategy could increase the emissions significantly (Dubash and Bradley 2005). India may be an exception to the rule that addressing poverty does not 'blow' the emissions budget. A multi-agency study estimated that achieving universal access to modern energy services by 2030 would require only 3 % of global energy investments in their New Policy Scenario, increase generation by 2.9 % and CO_2 emissions by only 0.8 % (IEA, UNDP, and UNIDO 2010).

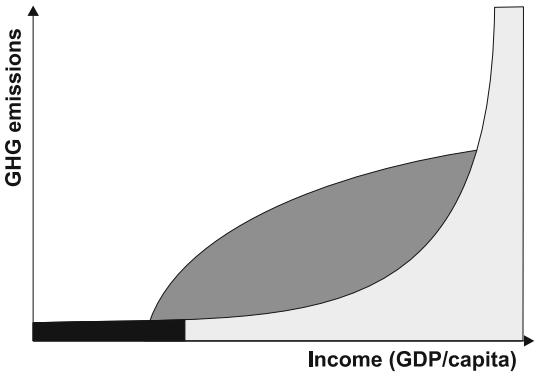

Fig. 4 Illustration of social contract changing patterns of over- and underconsumption. *Source*: own diagram. Poor classes (in *black*), emerging middle classes (in *dark grey*), rich classes (in *light grey*)

Box 5 Low-carbon development in Ethiopia

This does not preclude the possibility of poorer countries taking bold action. Ethiopia has adopted a green economy strategy, aiming to become middle income by 2025 by building a climate-resilient green economy. Considering growing power, transport, industry, and building sectors, rather than the traditional agriculture and forestry, is essential to this goal. Emissions would increase in absolute terms (to a projected 400 Mt CO_2-eq by 2030), but less than with a climate lens applied to Ethiopia's development path. The challenge is to avoid emissions, or an even higher-carbon development path (Ethiopia 2011)

More at issue are the one billion who live above what Rosling calls the 'airline' (Jackson 2010) spending more than USD 80 a day with high-consumption lifestyles (including the authors of this article) whose emission styles have to be addressed (Chakravarty et al. 2009). The richest need to finance the shift to renewable energy, reduce their demand for forest products, use less energy and more efficiently. The mind shift required is accepting that welfare and well-being do not depend on having more.

For the middle classes (and particularly those about to jump from the wash-line above the airline), the challenge is about aspirations. Rather than aspire to the high-consumption lifestyle, the middle class part of the social contract is to accept the challenge to their aspirations, and consider that they already have the material means to 'live well' (Box 5).

At the international level, this might suggest complementing the Millennium Development Goals (MDGs) with Millennium Consumption Goals (MCGs) (Munasinghe 2012) by addressing issues of poverty and inequality at a global scale. However, it seems likely that national development goals are more powerful drivers of low-carbon and climate-resilient development than global goals. A first step has been taken in the Sustainable Development Goals which includes one goal on sustainable consumption and production patterns (United Nations 2014).

6 Conclusion: reconsidering development by reflecting on climate

This paper has explored whether and how development paths could be changed, maybe with a climate lens, to meet development goals. It presented the drivers of development and their effect on emissions and unpacked the consumption and production patterns and the differences of these patterns across lower-, middle-, and higher-income groups.

We now conclude that development goals should be treated explicitly—politically and analytically—as policy objectives. Climate change must be place in the context of development. When mitigation analysis is not framed within development goals, it becomes irrelevant—because ultimately development is driving emissions, not the other way around. This implies re-examining development goals rather than pursuing climate goals. Development is practice, and climate is a reflection on development.

Thus, analysis must start from development goals (and not from climate stabilization or other climate metrics) and use climate policy as a self-control mechanism in the system. Methods that back-cast from desirable future development goals need to be further developed. Climate policy must be based on exploring different development paths. By explicitly modelling development paths, understanding of the difference in emissions can be improved. It requires addressing not only the low-emission parts, but also the high-emission parts of 'development'. Of course low-emission technologies, systems and policies will be part of the solution. Having explored possible development paths, the levers to change those paths need to be identified and analysed.

This calls for a debate about development and its nature. The obsession of the existing economic order (and much climate analysis) with economic growth has to be replaced by a discussion on the *quality* of development—the composition of an economy, not just its size; what constitutes well-being—consumption of material goods or other aspects—'bien vivir'.

This requires changing mindsets to support a social contract. Such a contract will require the rich to pay for mitigation, use less, and assist the poor; lift the poor out poverty—which does not imply a significant increase in emissions; and change aspirations of the middle class. All should aim to live well, rather than with more. Clearly, such a social contract will require timescales beyond short-term political terms or economic interests, and longer-term thinking.

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