



A review of sustainable development assessment literature that could be applied to NAMAs

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Published in:

Internalising mitigation activities into the development priorities and approaches of developing countries. Proceedings of the Forum on Development and Mitigation

Publication date:

2014

Document Version

Peer reviewed version

[Link back to DTU Orbit](#)

Citation (APA):

Boodoo, Z. (2014). A review of sustainable development assessment literature that could be applied to NAMAs. In M. Jooste, E. Tyler, K. Coetzee, A. Boyd, & M. Boulle (Eds.), *Internalising mitigation activities into the development priorities and approaches of developing countries. Proceedings of the Forum on Development and Mitigation* (pp. 1-33). Energy Research Centre, University of Cape Town.

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Title: *A review of sustainable development assessment literature that could be applied to NAMAs*

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Abstract: *The actual contribution of mitigation initiatives to national sustainable development (SD) has been widely debated amongst scholars. The operationalization of Nationally Appropriate Mitigation Actions (NAMAs) within the United Nations Framework Convention on Climate Change (UNFCCC) could help in reconciling two of the main thrusts of the UNFCCC; its emissions reduction and SD objectives. However, limited attempts have been made to explicitly link the two concepts through integrated approaches. The present paper discusses the existing theoretical considerations on sustainability assessments as tuned for a similar exercise on NAMAs by reviewing the relevant literature pertaining to the two bodies of knowledge. A number of features have been identified as conducive towards easing the assessment of the SD impacts of NAMAs. These include a classification of NAMAs that favours Measurement, Reporting and Verification, requirements for a combination of ex-ante and ex-post assessments, adoption of the Bellagio Principles in the framing of sustainability indicators, freedom for countries to define their own sustainable development vision and methodologies while recognising the limitations in the adoption of any chosen approach, framing of a minimum set of sustainability dimensions, integration of transformational change considerations in the design of NAMAs and the need to favour an informed deliberative discourse at country level while defining SD through the use of Multi-Criteria Analysis. The paper concludes with requirements for further research geared towards applying and comparing the use of similar approaches and methodologies across technologies, sectors and countries, as well as further clarity on conceptualising transformational change within the NAMA debate.*

Keywords: *Sustainable Development, Nationally Appropriate Mitigation Actions (NAMA), Methodologies, Sustainability Assessment, Co-benefits, literature review*

1.0 Introduction

The adoption of the United Nations Framework Convention on Climate Change (UNFCCC) has spurred a variety of climate change policies and initiatives across the globe. However, scientific studies and reports published thereafter have hinted that measures taken globally have not set the world in a development path that would prevent dangerous anthropogenic interference with the climate system as advocated within UNFCCC convention text (UNEP 2012, Bernstein, Bosch et al. 2007).

During the series of complex climate negotiations, Parties to the UNFCCC have agreed to set a long-term global goal of emissions reduction as part of a shared vision of long-term cooperative action, with Nationally Appropriate Mitigation Actions (NAMAs) contributing to this goal. To enhance the crucial participation of developing countries in global mitigation efforts, it was also agreed that NAMAs should be supported, and that support be subject to measurement, reporting and verification (MRV), along with the setting up of a registry of NAMAs (UNFCCC 2011).

It can be argued that such MRV requirements require a minimum of structure and rigor in terms of methodology so as to ease the assessment of the likely impacts of NAMA initiatives prior to implementation for priority setting, as well as their actual efficiency throughout their lifetime for analysis of results obtained and strategic re-orientations, if needed. Moreover, improved methodological requirements will improve transparency and hence credibility in the process, especially to enable a fair channelling of financial and technical resources from donors to recipients from developing countries.

However, adjustments made to accommodate the varying viewpoints of different Parties to the UNFCCC, coupled with the concise nature of the wording utilised have led to wide understanding of the agreement related to NAMAs (Linnér, Pahuja 2012). Issues have thus been raised on their operationalisation, including support, MRV mechanisms, as well as accounting. Moreover, the decision on an essential NAMA registry has not included criteria for sustainable development (SD) but rather encourages countries to develop their low carbon development strategies “in the context of sustainable development” (UNFCCC 2011). This overlook could hinder the design of an effective NAMA registry – a flaw that would prevent the assessment of the sustainable development and other co-benefits of NAMAs. Experiences from the Clean Development Mechanism (CDM) have also shown that leaving SD to be defined at the national level have not allowed SD dimensions to be fully taken into consideration in CDM projects (Olsen, Fenhann 2008), with the limited capacities of developing nations as well as opposing agendas of different CDM stakeholders being cited one of the reasons (Kim 2003).

Though SD criteria have not yet been included in core NAMA proposals, the latter should be understood in context of SD, in line with Article 3.4 of the UNFCCC Convention text (Linnér, Pahuja 2012). With NAMAs aspiring to be game changers, Parties could be expected to explain how NAMAs could contribute to systemic change by promoting SD and reducing emissions.

As a relatively newly framed mechanism, literature that explicitly relates NAMAs and their SD impacts is scarce and fragmented, with a wide range of approaches being used by authors ((Winkler, Howells et al. 2007); (Winkler, Hoehne et al. 2008); (Román 2012); (Dubash, Raghunandan et al. 2013); (Garibaldi, Winkler et al. 2013); (Olsen 2013); (Tyler, Boyd et al. 2013)). Expanding the screening process to previous assessments of sustainable development benefits of a wider range of mitigation measures reveals a majority of studies that have either focussed on the CDM, taken a sectoral approach or both ((Huq 2002); (Olsen 2006); (Schmitz 2006); (Heuberger, Brent et al. 2007); (Olsen 2007); (Sutter, Parreño 2007); (Olsen, Fenhann 2008); (Musango, Brent 2011); (Huang, Yang 2012)). In this context, it can be argued that the body of knowledge on NAMAs could be enriched by taking a bird's eye perspective towards sustainability assessments of NAMAs through adopting an integrated approach that could address the following research question; *how can existing theoretical considerations on sustainability assessments inform a similar exercise applied to NAMAs?*

On top of contributing to the body of knowledge regarding expanding theoretical considerations and viewpoints on NAMA linkages with sustainable development, such an exploration has a number of empirical advantages, as highlighted by scholars such as (Bakker, Huizenga 2010), (Lütken, Fenhann et al. 2011), (Hinojosa, Lütken et al. 2012), (Linnér, Pahuja 2012), and (van Tilburg, Röser et al. 2012);

- a) Sustainable Development Assessment of NAMAs could help track their successes, build domestic political support, and monitor wider benefits given the broad and transformative nature of NAMAs,

- b) contributing towards the establishment of methodologies for MRV of those NAMAs wherein direct quantification of emissions reduction is not direct e.g. by providing options for other processes or proxy indicators,
- c) informing discussions that have been called upon at climate negotiations regarding methodologies for ex-ante estimations of Sustainable Development and co-benefits of NAMAs,
- d) providing additional guidance through clear and transparent criteria from prospective funders to make NAMA proposals more bankable while attending to the needs and circumstances of developing countries,
- e) providing guidance to a potential new Executive Board for NAMAs under the UNFCCC, similar to the CDM Executive Board, informing its possible methodology panel on what seems to pose difficulties for countries when proposing NAMAs and which tools might be helpful.

As a further guide to the review, the above empirical considerations have been considered as expected outcomes, the extent of which needs to be maximised, while being informed by existing theories on sustainability assessments. However, an initial screening focussing exclusively on sustainability assessments literature has revealed a number of intrinsically linked bodies of knowledge that cannot be dissociated from such assessments, occurring both upfront and downstream of the process of undertaking the task of gauging the SD impacts of an initiative. These include the concept of SD in itself, the use of indicators and policy evaluation techniques.

With a view towards devising methodologies that could enable the assessment of the SD impacts of nationally appropriate mitigation actions, some fundamental assumptions must be made; amongst which one of the primordial ones being that there is a common understanding of the two concepts. However, there seems to be as much meanings of the term "sustainable development" as there are authors trying to describe it (Hopwood, Mellor et al. 2005), while the international climate community is yet to agree on a common definition of the term "Nationally Appropriate Mitigation Action", if ever the Conference of Parties (COP) to the UNFCCC gets mandated to do so. Faced with two hazy theoretical notions, some clarity of meaning is thus essential, especially so as to be able to justify those fundamental assumptions required to devise an appropriate methodology to measure SD impacts of NAMAs. On a more downstream level, undertaking sustainability assessments will only make sense if they are supported through appropriate indicators and evaluated using an appropriate methodology.

For reasons of breadth of coverage and space limitations, the present paper will only focus on some conceptual understandings of NAMAs *per se*, followed by a review of the debates around framing SD and a critical review of SD assessment tools and SD indicators and frameworks as could be applied to NAMAs, with insights on desired characteristics that could be required to assess the co-benefits of NAMAs. It is to be noted that the purpose of this paper is not to come up with a silver bullet methodology for assessing co-benefits of NAMAs that could be applied universally, but rather to critically analyse the applicability and relevance of different stances that may have a practical application, as grounded in theory. Peer-reviewed articles have been sourced from Web of Knowledge and Google Scholar, complemented with publications from recognised institutions and grey literature from the internet.

2.0 Conceptualisation

2.1 The NAMA mechanism

International climate negotiations have often stalled, with sovereign nations disagreeing on whether support should be delivered first or actions shown by developing country Parties before

support being provided by developed ones. The concept of NAMAs has thus been coined as a means to incentivise developing country parties to assume a share of the essential reduction of emissions needed to avoid dangerous climate change, while enabling countries to develop sustainably and in light of their national circumstances ((Lütken, Fenhann et al. 2011)(Okubo, Hayashi et al. 2011); (van Tilburg, Röser et al. 2012)). NAMA pledges could be expected to take precedence over the model of Kyoto Protocol's commitments, though the concept has yet to be operationalised by Parties.

The notion of NAMAs formally stems from the adoption of the Bali Action Plan at the 13th Conference of Parties to the UNFCCC as a framework that clarifies the engagement of developing countries in mitigation actions. Some conceptual similarities can also be traced to the Sustainable Development Policies and Measures (SD-PAM) mechanism, wherein SD-PAMs are described as "policies and measures that are aimed at meeting the domestic objectives of the host country, but that also bring significant benefits to the climate through reduced GHG emissions" (Bradley, Baumert et al. 2005). The concept of NAMAs deviates from the nature of carbon markets, whereby mitigation measures are implemented and development benefits are expected to trickle down, towards a new paradigm emphasising on development measures that bring ancillary emissions reduction benefits.

To-date, no official definition of NAMAs has been agreed at COP level, though some authors have tried to describe NAMAs. A compilation of meanings of the term "NAMA" within published literature at the time of writing is at Table 1 below;

Table 1: NAMA Typologies

Category	Typologies	Description	Author(s)
Financial flow - focussed definition	Unilateral NAMAs (domestic NAMAs)	mitigation initiatives that are domestically funded and unilaterally implemented	(Linnér, Pahuja 2012, Hinostroza, Lütken et al. 2012)
	Supported NAMAs (international NAMAs)	mitigation is enabled by developed country support	
	Credited NAMAs (allowance NAMAs)	carbon credits could be generated and traded on an international emissions market, similar in nature to the current Clean Development Mechanism (CDM)	
Nature of intervention –focussed definition	Projects	such as a localised capital investment in either infrastructure or machinery, e.g. construction of concentrated solar power plant, a bus rapid transit system or deployment of energy efficient industrial motors.	(van Tilburg, Röser et al. 2013)
	Policies/regulations	government-led initiative aiming for inclusion in law, e.g. Feed-in tariff, Emissions trading scheme, Building code	
	Strategies	long term comprehensive plan of measures and actions designed to achieve a common goal. It contains many types of activities with	

		various degrees of impact: e.g 20% Renewable Energy target backed by a market and regulatory strategy to break barriers in RE development. Master plan to improve transit management.		
Mitigation objective – focussed definition	Goal Specifying NAMAs	Economy-wide goals	<ul style="list-style-type: none"> Absolute reduction target, e.g. <i>reducing emissions by 25 % below 1990 levels by 2020 (Antigua and Barbuda)</i> BAU deviation target, e.g. <i>reducing national emissions by 30 % from BAU emissions in 2020 (South Korea)</i> Intensity target e.g. <i>reduce emissions intensity of GDP by 20-25 % by 2020 compared to 2005 level (India)</i> 	(Sharma, Desgain 2013) adapted from submissions obtained from the Copenhagen Accord
		Sectoral goals	<i>e.g. Increase forest cover from 7 % in 2005 to 30 % in 2050 (Togo)</i>	
	Non-Goal specifying NAMAs	Focus Areas	Generic sub-sectoral, sectoral or cross-sectoral mitigation options with no specific goals or measures attached to them <i>e.g. energy efficiency, promotion of renewable energy</i>	
		Measures	Specific policies, regulations, or technology initiatives <i>e.g. standards in building sector, promotion of low energy light bulbs</i>	
		Specific Actions	project or technological action in a specified location <i>e.g. 450 MW hydropower project in Ethiopia</i>	
		Others	e.g. preparation of national communications (Afghanistan), preparation of comprehensive SD programme that prioritise renewable energy and energy efficiency (Mauritius)	
Reporting channel – focussed definition	Copenhagen Accord	Country submissions to Copenhagen Accord	(Tyler, Boyd et al. 2013)	
	Registry submissions	Actions registered on the UNFCCC web-based registry		
	Mitigation Action	All other types of mitigation actions in a developing country, without regards to formal communications to the international community		

As can be observed from Table 1, scholars and practitioners have pre-supposed a wide array of meanings for NAMAs, depending on their area of focus, ranging from finance, nature of intervention, mitigation objective and reporting channel. Such divergences are due to the fact that an agreement has not yet been reached at COP level regarding a common definition for the term. With NAMAs being developed bottom up, such a universal definition might never be formalised, though some common elements can be reasonably expected to emerge. (Tyler, Boyd et al. 2013) observes a certain convergence in NAMA literature towards understanding NAMAs as UNFCCC registry submissions. Common to the four categories identified in Table 1, NAMAs can be viewed as a new conduit through which developing countries will either ambition to have national measures with emissions reduction benefits recognised or attempt to market and negotiate international development projects – hence compete for channelling of climate finance, through a structured and argued logic, with quantification wherever possible of the benefits of such NAMAs with a view to maximise the opportunity for favourable financing outcomes.

Though it can be argued that the open-ended interpretation of what can be described as nationally appropriate within a developing country can enable encapsulation of nearly any initiative that has mitigation co-benefits, such definitional uncertainty could also hinder mitigation ambitions (Tyler, Boyd et al. 2013), especially when a structured and strategic approach towards NAMAs is envisaged, such as integration within a Low Carbon/Emission Development Strategy. The need for such strategic planning has been advocated within the Cancun Agreements, with scholars such as (Lütken, Fenhann et al. 2011) and (Hinostroza, Lütken et al. 2012) understanding such a requirement as the need for NAMAs to be mainstreamed into multidimensional long-term development planning, revisited with additional set of criteria and operating along an overarching framework of “Low Carbon Development Strategies”. Being embedded in national policy, NAMAs are expected to enjoy the appropriate level of political support (van Tilburg, Röser et al. 2012). It can thus be argued that the faster the UNFCCC COP provides better clarity onto elements that should constitute a NAMA, the easier it will be to progress on up-scaling mitigation ambitions by non-Annex 1 Parties. Moreover, it can also be argued that quantification, wherever possible, of SD outcomes of NAMAs can promote the efficient operationalization of the mechanism.

2.2 Proposed NAMA framework

In line with the argument that national appropriateness of a mitigation initiative would require abiding with a country's existing or planned developmental policy and strategic orientations, it can be argued that NAMAs, in one way or the other, would require governmental support in its operationalization at a national scale, with the support of the private sector, and civil organisations. Private sector activities being generally market-driven, the success of a NAMA will, amongst other conditions, be dependent on the ability of government to create the necessary conditions that would ease implementation of a NAMA. Whatever mitigation measure, whether solely public, exclusively private sector-driven or involving both parties, effective governmental frameworks are a key element to consider towards the successful implementation of a NAMA. However, public bodies generally operate within governance structures that are bound by more rigid regulatory frameworks and procedural requirements as compared to private entities – a situation that is fair in view of the enhanced requirements for transparency and accountability involved in the management of public funds, while operating within larger institutional frameworks as opposed to individual private bodies. This relative rigidity can impede the smooth implementation of NAMAs, including assessment of their sustainable development and other impacts. With a view to attend to the decreased flexibility in manoeuvring, NAMAs should thus be framed in such a way that public sector oversight and

operational be eased. To this end, it has been deemed important to reflect such considerations within a NAMA framework, as pictured in Figure 1.

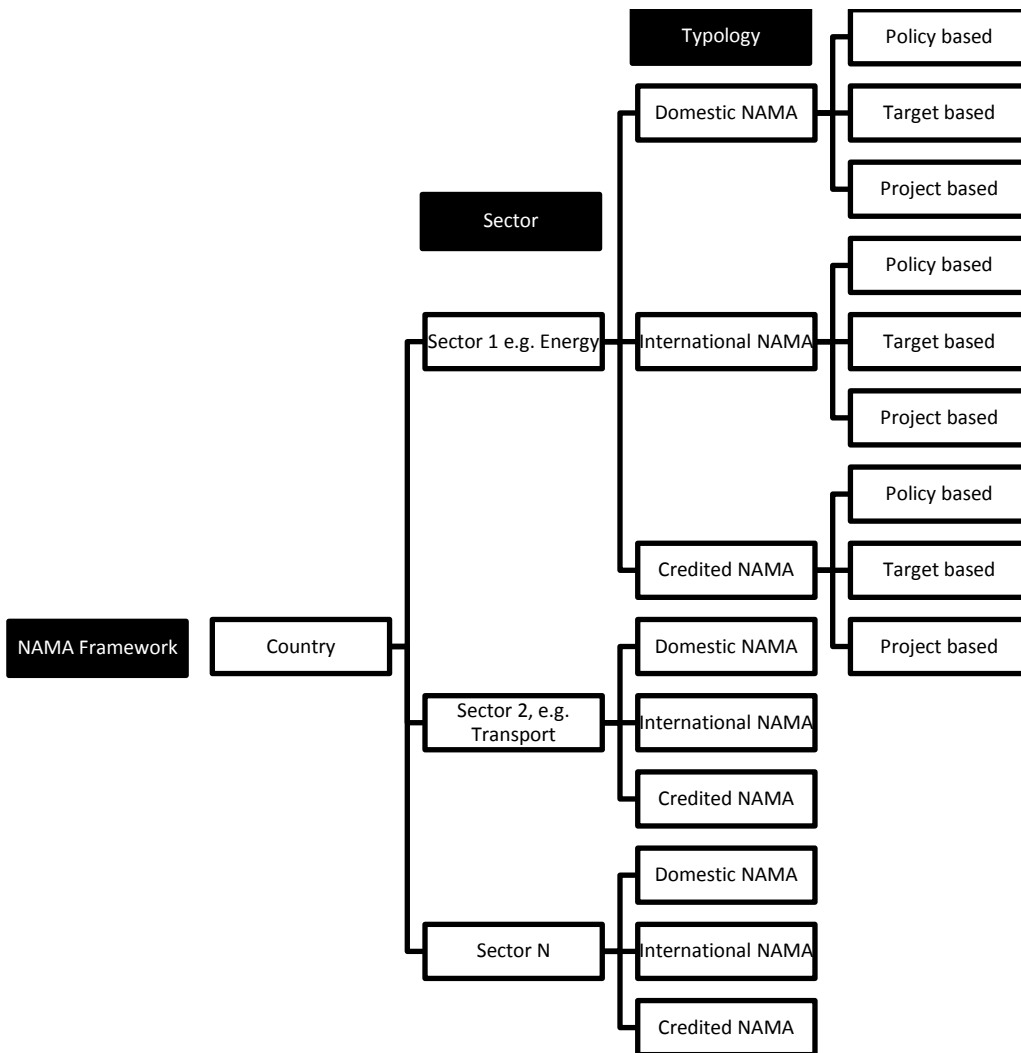


Figure 1: NAMA framework

In view of the common public management practice of delineating responsibilities for implementation of public initiatives as being stratified according to sectoral themes, a sector wise categorisation is viewed as bearing good promise in terms of defining NAMAs. Coordination of sector NAMAs will thus be easier with regard to expected MRV requirements of sustainable development impacts.

Having classified NAMAs on a sectoral basis, further classification in terms of reporting intent has been deemed important – whether the NAMA is only meant for international recognition of a national measure (domestic NAMA), or for international funding (International and Credited NAMAs), since each type of NAMA can be reasonably expected to have differing stringency of MRV requirements. MRV of domestic NAMAs could make use of existing reporting structures such as from Statistics Offices, line ministries and other stakeholder institutions, amongst others, and with the assessment of impacts being expanded to cover the scope of the NAMA in question. Being embedded within an existing sector or ministry, such reporting will be made

easier. International and Credited NAMAs, on the other hand, will need to attend to more stringent MRV requirements. A sectoral or ministerial "one-stop-shop", operating as a national focal point will be most useful, in terms of coordination, implementation and MRV of the sustainable development and other impacts of NAMAs.

Following the sectoral and reporting classification, a further categorisation in terms of the nature of intervention (policy, target and/or project) NAMAs can further enhance conceptual clarity with a view to devise MRV frameworks at a country level.

With climate talks evolving more and more towards conceptualising NAMAs as a major new cornerstone within international climate policy driven by their sustainable development benefits, undertaking an assessment of the SD impacts of NAMAs can only help into the process. However, understandings of the term "sustainable development" are even more divergent than that of "NAMAs". A review of the fundamental principles that guide the SD debate has been deemed of relevance, especially in the wake of some scholars, referring to the vagueness in definition, describing SD as an oxymoron (Redclift 2005) or "an open door towards fostering delusions" (Robinson 2004). The following section will thus attempt to review the different ways SD is conceptualised, as well as position NAMAs within such a context.

2.3 Sustainable Development – the debate

Critiques towards sustainable development as an "ideal" have raised a number of issues that seem to saddle the concept. In his review of the sustainability literature, (Lele 1991) opines that the weakness of the sustainable development notion lies in its strength, *i.e.* although the wide interpretative nature of the concept of SD implies political acceptance, its lack of intellectual clarity and rigour prevents it to become a meaningful paradigm of development. (Hopwood, Mellor et al. 2005) further claim that its looseness could be used by decision makers – politicians and business leaders, to legitimate virtually any policy or practice without any commitment towards undertaking the essential challenges needed to their business-as-usual path. (Daly 1993) further criticises the idea of "sustainable growth" as being meaningless within a system whereby economic growth is dependent upon finite ecosystems.

While a universally agreed and clear definition of sustainable development is desirable, in practice, it is highly unlikely that such an agreement be reached, especially since this involves disentangling the debate from political acceptance and respect for sovereignty of nations in defining their own visions of what is deemed as sustainable within their national circumstances. To this end, some trade-off is required, such that a definition for sustainable development should be broad enough to encapsulate varying views, and concise enough to enable cross country harmonisation within essential dimensions of sustainability. Within the NAMA debate, this could entail a minimum number of SD aspects that could be required as essential dimensions across nations, while leaving specific details to be defined at a national level. The following sections will thus attempt to analyse the major attempts undertaken by a number of scholars to categorise sustainability discourses across several angles, philosophical stances and interpretations, with the aim of identifying fundamental principles that could guide an assessment of SD impacts of NAMAs, comparing the relative advantages and limitations of adopting different conceptual framings, as well as identifying desirable characteristics of such framings that could ease the assessment process.

Originating from the concept of sustainable yield from renewable resources such as forests and fisheries (Lele 1991), the concept of sustainability was most famously first pushed within the area of public debate through research undertaken by The Club of Rome (Mitcham 1995), which was subsequently published within "The Limits to Growth" (Meadows, Meadows et al. 1972),

and picturing catastrophic consequences of traditional global growth patterns. In its Second Report to the Club of Rome, the tone was shifted from a discourse picturing catastrophic failure of global systems towards a more pragmatic one relating to what could be done – from "development" towards "development that is sustainable" (Mesarovic, Pestel 1974). This paradigm shift was further enhanced through publications of "The World Conservation Strategy" in 1980 by the International Union for the Conservation of Nature and Natural Resources and "Our Common Future" by the World Commission on Environment and Development in 1987.

The definition that is described in the Brundtland Commission report as "... development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987), is thus a compromise made to cater for the competing interests of

- i. environmentalists, who were arguing for limits to growth with a view to tackle pollution, protect natural resources and cater for future generations, and
- ii. economists, especially from Third World Countries, advocating for more development and growth.

This anthropocentric, two-pillar interpretation of sustainable development, thus a trade-off to be made between ecological sustainability and satisfaction of basic human needs, has been dominating the SD debate since then. In short, sustainable development challenges the assumption that increased global trade and industry can succeed in bringing international prosperity and human well-being (Hopwood, Mellor et al. 2005), while also recognising the failure of traditional growth models at tackling environmental and equity concerns. Since Brundtland's popularisation of the term, SD has reached mainstream international environmental policy, especially through implementation of Agenda 21, as a unifying concept for worldwide development activities (Estes 2004), bringing together actors from different disciplines and sectors with varying theoretical and ideological perspectives.

The ideology whereby some balance is to be sought between competing dimensions has prevailed across the sustainability debate. It can be argued that such a predisposition to favour a democratic discourse should also prevail while attempting to assess the sustainability of NAMAs, operating as a fundamental principle. However, such a quest for balance amongst sometimes converging and often diverging interests has led to wide conceptual framing of the meaning of "sustainable development" amongst scholars and practitioners alike, which have implications on attempts to assess the SD impacts of an initiative.

2.4 Pillar-based description

One recurring feature in the attempt for definitional clarity visualises SD as comprising of a number of pillars that represent the foundations of sustainability. The most common one is the three pillars or triple bottom-lines (Hacking, Guthrie 2008) which visualise SD as comprising of environment (bio-physical), social and economic dimensions. Some scholars such as (Pope, Annandale et al. 2004) consider the "triple bottom-line" assessment as one that accounts equally for each within decision making. However, other authors have expanded the scope of the pillar-base description. (Estes 2004) further described the social dimension of SD into political and cultural concerns. (Pawłowski 2008) advocated for considerations across a set hierarchy operating within seven spheres - the moral, ecological, social, economic, legal, technical and political dimensions and (Bossel 1999) increased the sophistication of description from a pillar based concept into a system-based description with considerations extending as far as material and psychological spheres as describing what could be conceived as "sustainable".

The triple bottom-line discourse in SD, which varies from "weak" to "strong" sustainability concepts, has been the most commented one in literature. Weak sustainability considers that nature and human-made capital can be interchanged and the goal of such models being related towards maintaining total capital stocks (Robinson 2004). Gaps such as lack of resources are considered as compensable through progress in technology (Hopwood, Mellor et al. 2005). Weak sustainability models (Figure 2) is commonly described as three concentric circles picturing social, environmental and economic aspects, with sustainable development lying in the centre of the three circles (Connelly 2007).

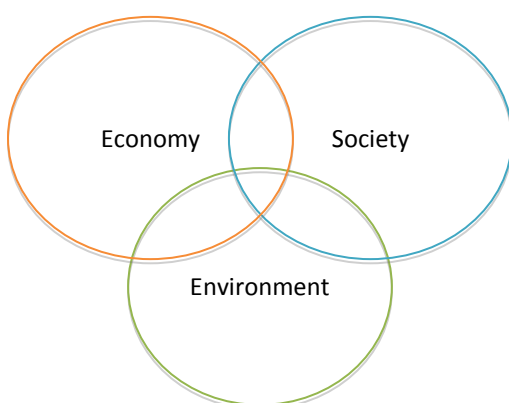


Figure 2: "Weak" sustainability

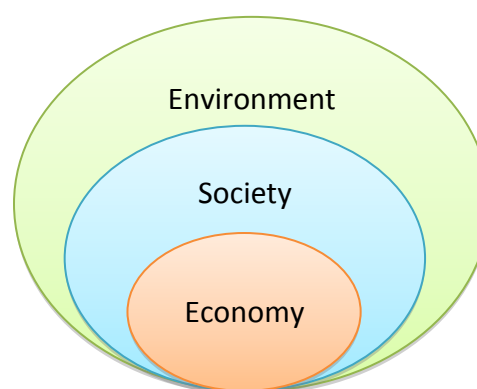


Figure 3: "Strong" sustainability

Strong sustainability, on the other hand, refers to an ecological sustainability model that relates towards finding a way to live within the limits of natural sources in view of the fact that source and sink functions provided by natural resources are finite. Conversely to weak sustainability, the argument here is that some natural capital stocks are "incommensurable and non-substitutable" (Robinson 2004), and thus must be maintained independently of the growth of other forms of capital. It is commonly represented as in Figure 3. (Neumayer 2003) further posits for two type of strong sustainability; preservation of nature in value terms and preserving physical stocks of some forms of natural capital.

As a mechanism that operates within a convention that is focussed on climate concerns and assuming a pillar-based description of SD, it can be argued that a strong sustainability perspective is preferable in assessing the SD impacts of NAMAs. However, the multi-disciplinary nature of climate issues as well as related development concerns have also been recognised (Sathaye, Najam *et al* 2007) and thus calls for a balanced stance across pillars, though limits to emissions should be factored into whatever SD stance that is adopted.

Moreover, conceptualising SD within pillars has a number of limitations. Those include the following points that have been noted by (Gibson 2001) and (Pope, Annandale et al. 2004) regarding the triple bottom line concept, but which can be generalised to any pillar-based description of SD;

- it does not factor in the linkages and interdependencies of the pillars and focuses on the potentially competing interests amongst them,
- there is a tendency to promote trade-offs at the expense of one of the pillars, usually the environment one,
- there is a risk to oversee some sustainability-related discourses that do not fall into the pillars,

- run the risk of the sum of parts being less than the whole if the interrelations are not adequately understood or described, and
- the pillar based notion is restrictive and does not challenge conventional thinking and practice.

A pillar-based description of sustainability for NAMAs will thus have similar limitations. However, while exploring the literature, sticking only to the above mainstream description has been found as rather restrictive, since other relevant types of framings could also be relevant to NAMAs. With a view to deepen the ways in which SD are modelled, the concept of mind-maps will be discussed in the following section.

2.5 Mind-maps

Human-nature relationships can be viewed from different lenses through mind maps – pre-analytic ideas or high generality mental constructs, which, in turn, determine the data needs, questions asked and views of the world to accommodate new results (Glaser 2006). (Hopwood, Mellor et al. 2005) has mapped the different views on SD across environmental concerns ranging from low, through technologically centred, to eco-centred viewpoints and socio-economic perspectives covering the importance given to human well-being and equality. To achieve SD, three types of changes required can be envisaged (*Ibid.*);

- status-quo, representing the view that such changes can be achieved within present structures,
- reform, representing the view that deep reforms are needed without significantly disrupting existing arrangements, and
- transformation, representing the view that the issues to achieve SD lie with economic and societal foundations which need to be radically changed.

With NAMAs aspiring to contribute significantly within global mitigation, it can be argued that a transformative change will be most adequate. This point of view can be expected from NAMA funders who will wish to maximise the return on "investment". The NAMA Facility, launched by the UK and German governments to fund NAMAs have already included, amongst other eligibility criteria, the potential for transformational change for financing of NAMAs (International NAMA Facility 2013).

Focussing on the inclusion of social aspects of sustainability, a wider and deeper analysis has been undertaken by (Glaser 2006), whereby four types of mind-maps have been analysed as a means to compare the pros and cons of alternative concepts of human-nature relationships, as summarised in Table 2 below;

Table 2: Human-nature mind-maps (adapted from (Glaser 2006); p 135)

Type of mind-map	Description	Pros and Cons
eco-centric	social needs are considered as secondary to requirements of nature	While eco-centric mind-maps recognise humanity as being embedded in nature and provide the foundation for the quantification of eco-physical limits to human-nature relationships, they reduce the social dynamics and linkages to a simplistic linear model.
anthropocentric	defines nature in terms of goods and services it delivers to humanity	Though anthropocentric mind-maps has enabled a comprehensive view of nature's services to humanity as well as increased

		inclusion of some social dimensions, they either ignore or oversimplify the bio-geo-physical limits to human use of nature and contribute to ecosystems degradation. Denial of the existence of nature also hinders interdisciplinary cooperation.
inter-disciplinary	attempts to address ecological, economic and social dimensions of ecosystem management in a balanced way	Interdisciplinary mind-maps (which include triple bottom line assessments) have enabled analysis of social variables such as institutional and legal processes in ecosystems management but have ignored fundamental social drivers such as values, needs, knowledge, power structures and culture.
complex systems	attempts to analyse human-nature dynamics by concentrating on intersystem linkages and combining these with internal subsystem dynamics at various temporal, institutional and spatial scales	Complex systems mind-maps could theoretically provide a better framework that includes social dimensions while allowing for trans-disciplinary knowledge generation, but lacks refinement to cater for complexity, uncertainly, non-linear feedback, cross-scale interactions. Moreover, such systems could view humans as being driven <i>in lieu</i> of being capable of reflection and adaptation.

Though the adoption of a purely eco-centric or anthropocentric mind-maps provide good potential in terms of quantification applicability, those mind-maps exhibit limitations in terms of factoring the social dimensions of SD. As mentioned by (Glaser 2006), scientific endeavours of societal relevance, NAMAs in this case, would have limited use with the use of approaches that focus exclusively on selected disciplines or on separate parallel spheres. With a NAMAs being implemented primarily for SD concerns, the social dimension will be of high importance in their implementation. Glasner (2006) further recommends the use of complex systems mind-maps in view of their advantages of allowing 'integrative analyses with the participation of system stakeholders in transformative and adaptive trans-disciplinary work'. From the comparative analysis in Table 2, a complex systems perspective for assessing the sustainability of NAMAs could be a plausible option, especially with a view to include the social dimension of NAMAs as framed within a democratic discourse. However the complexity of such an approach could also be a deterrent.

With the conceptual understanding of sustainable development being so much value-laden, time constraint (covering inter and intra-generational concerns), multidisciplinary and cross-sectoral, tools to be used to assess transitions towards sustainability need to cater for a combination of goals to be achieved, while considering the complex dynamic relationships between the differing dimensions of sustainable development – hence requiring country-specific democratic debates on the issue. This also implies the recognition that multiple and possibly irreconcilable viewpoints are likely to exist and thus no single approach could be seen as the correct one ((Robinson 2004); (Glaser 2006); (Connelly 2007)) and that the actual meaning of the term can only emerge as a process in the course of interdisciplinary and intercultural discussions (Mitham (1995) , Pope, Annandale et al. (2004)). Within the wealth of developing countries that are expected to submit NAMAs, and with each one working within its own particular context and its own vision of sustainability, it will be more reasonable to adopt democratic principles whereby the door is left open for each NAMA participating country to adopt its own particular

mind-map, while explicitly recognising the associated limitations within the choice made for each NAMA.

This perspective could provide for elements that could lead to a compromise with developing countries as regards to their reported reluctance for an international standard for sustainable development which would impinge over their sovereignty (Olsen 2013). The argument is also in line with (Bond, Morrison-Saunders 2011)'s statement that political realities needs to be factored into the process of designing sustainability assessments so as to ensure that sustainable outcomes are achieved, due to the fact that different stakeholders have different viewpoints of what the outcomes should be. To this end, a framework for undertaking their sustainability assessment would be crucial. In this respect, the different existing sustainability assessment frameworks will be discussed in the next sections.

2.6 Existing SD Assessment Approaches

The study of sustainable development, sustainability, sustainability science and its corollaries is a topic that, *stricto sensu*, requires convergence from different spheres of academia. Despite a significant amount of research representing over 25 years of efforts, to-date, scholars have not been able to settle on "one-size fits all" tools that could be utilised to gauge progress towards sustainable development. It is to be noted that such universality claims has not been the aim of those studies conducted. This is probably due to the inherent inter- and trans- disciplinary nature of sustainable development – a state of affairs that dictate informed discussions amongst various actors. The intrinsic link between one's personal interpretation of sustainability and the choice of a particular tool to undertake the assessment has been highlighted by (Ness, Urbel-Piirsalu et al. 2007) and (Gasparatos 2010). Such differences in understanding can unavoidably lead to disappointment amongst participating stakeholders (Bond, Morrison-Saunders 2011).

Originating from environmental assessment tools dating back to the 70's, sustainability assessments were described within one of the first laws governing Environmental Impact Assessments (EIA) in the USA as a decision support tool (Bond, Morrison-Saunders 2011). (Pope, Annandale et al. 2004) traces back the conceptual origins of sustainability assessments towards Strategic Environment Assessments also, with a demarcation amongst two tools that set a direction towards a sustainable outcome target. These comprise of;

- i. EIA-led integrated assessments, whereby evaluation are done ex-post, aiming to minimise negative impacts across the three pillars by comparing impacts as opposed to a baseline (representing weak sustainability and trade-offs between pillars), and
- ii. "objectives-led" assessments, whereby evaluation are estimated ex-ante, aiming to maximise positive impacts across the three pillars by comparing expected performance against aspirational environmental objectives instead of a baseline (sustainability is envisaged as a series of societal goals and measures contributing to those goals across the three pillars).

Picturing sustainability assessments of NAMAs within the above description would call for a mix of both approaches. Prior to an international recognition of an initiative as a NAMA, it can be argued that an initial ex-ante approach, similar to "objectives-led" assessments will be required. Subsequently, an ex-post evaluation, similar to "EIA-led" assessments would be essential to monitor the actual benefits that would have been claimed, thus explicitly justifying a NAMA as following a "sustainability path" defined by a country. This perspective implies that the establishment of a licencing system could be required for a domestic NAMA, such as a "NAMA Impact Assessment" at a national level inspired from similar institutional arrangements for processing of EIA licences. For international NAMAs, such an arrangement could be complemented with a verification system undertaken by the donor country or institution, while

credited NAMAs could require a third-party verification system, similar to Designated Operational Entities that currently prevails within the operating framework for the Clean Development Mechanism.

However, a number of other factors need to be considered when choosing a methodology for undertaking sustainability assessments. In his analysis, (Gasparatos, Scolobig 2012) further distinguish between bio-physical, monetary, and indicator-based tools, with each category of tools representing different valuation perspectives of the assessment, the adoption of reductionist/non-reductionist perspective during the assessment and the acceptability of trade-offs between the different sustainability issues.

In line with (Bond, Morrison-Saunders 2011) and (Gasparatos 2010), (Gasparatos, Scolobig 2012) express that distorted sustainability evaluations could be obtained through the choice of a tool that neglects the valuation perspective of the affected stakeholders. Different tools will thus be more appropriate to cater for different value orientations that humans could exhibit towards the environment (*Ibid.*), comprising of;

- a) concern for other humans (termed as "social-altruistic"),
- b) concern for non-human species (termed as "biospheric"), and
- c) self-interest (termed as "egoistic").

The need for such a categorisation is justified from the reported opposition towards the use of neoclassical monetary valuation from eco-centric stakeholders and expected preference for the use of monetary tools for stakeholders having egoistic and social-altruistic value orientations (Gasparatos, Scolobig 2012).

(Gasparatos, Scolobig 2012) further opine that lack of sound theoretical basis has often undermined tool selection, with choices being usually dependent on the time, data, and budgetary constraints, skills of the analysts and range of accessible tools. Moreover, the mere choice a particular evaluation tool can have significant influence on its outcome. (Gasparatos 2010) has classified major SD assessment tools as adopting either a reductionist or non-reductionist principle as described in Table 3.

Table 3 Types and approaches of sustainability assessments (adapted from (Gasparatos 2010))

Sustainability assessment type	Approach
Economic tools	Reductionist
Biophysical models	
Indicator lists	
Multi-Criteria Analysis (MCA)	Non-Reductionist

Despite the advantage of simplicity that is obtained through summarising diverse aspects of project to a small set of numbers (Gasparatos 2010), adopting a merely reductionist's approach, that is, splitting a complex problem into smaller units to ease decision making, implicitly ignores the complex interactions within sub-components that contributes towards the effectiveness of a system (Bond, Morrison-Saunders 2011). Reductionists' approaches will thus impose a certain broad value system to stakeholders without their prior consultation (Gasparatos 2010). The characteristics of approaches outlined in Table 3 are summarised below (Gasparatos 2010);

- Monetary/economic tools will put more focus on the satisfaction of human preferences (whereby happiness is equated with maximising consumption),
- Biophysical models will mostly gauge appropriation of natural capital (neglecting human preferences),

- Composite Indicator choice and assigning weights within indexes will, in itself, represent value choices

A holistic approach – whereby stakeholders are systematically involved in defining visions and means to achieve visions of sustainability, is thus more desirable, though limited research have been reported to-date on value-capturing tools. As pictured in Table 5, within the family of indicators, MCA is the one that exhibit non-reductionist properties. However, composite indicators lose their concept of value upon normalisation and aggregation of indicators. In view of the broad consensus-building nature of SD, assuming either an eco-centric or anthropocentric perspective could most likely lead to dead-locks amongst different actors of society – with expected debates about the right philosophical stance to adopt. To this end, the "Composite Indicators" tools bear the most promise in terms of consensus-building potential, with the added advantage of having the most prospect of being understood by a wider audience.

Though its nature resemble composite indicators, the advantage of MCAs lies in the absence of aggregation of indicators which avoids getting entwined in trade-offs debates between different sustainability issues (Gasparatos 2010). On the other end, overly holistic principles could cause decision makers to get entangled into conceptual understandings of complex interactions of sub-systems. Here again, a right balance between the apparent simplicity of a reductionist's approach and some combination of a more holistic approach seem to be more reasonable. The Committee on Radioactive Waste Management in the UK, in the process of defining a long-term strategy for the management of radioactive wastes, has adopted such a mix in approaches by combining the use of expert scaling within a MCDA process along with stakeholder weighing ((Morton, Airoldi et al. 2009)(Bond, Morrison-Saunders 2011))

The same issues can be expected when applying it to NAMAs. (Gasparatos, Scolobig 2012) recommends either the use of a combination of assessment tools (such as biophysical tools, indicator tools and monetary tools) that covers the value orientations of affected stakeholders, while acknowledging the issues and challenges involved in attempting to combine conflicting value judgements, especially altruistic ones. A democratic discourse towards choosing an appropriate tool at a country level could theoretically allay difficulties in tool selection at a national level. However, applying such a wide interpretation of choice within NAMAs can be tricky and increase the difficulties to enable cross country comparisons or achieve standardised minimum properties for sustainability assessments. In that respect, MCA could be a plausible option to assess sustainability of NAMAs as a tool that can combine such value judgements.

2.7 Desired characteristics

On top of the need to capture different value judgements across countries, a number of authors have captured desirable characteristics of sustainable development assessment tools. Sustainability assessments should;

- a) be comprehensive (i.e. covering the different themes of sustainable development so as to be able to posit for the full range of impacts of an initiative), integrated (assessment techniques used and themes covered that are aligned, connected, compared or combined) and strategic (having a wide forward looking perspective) (Hacking, Guthrie 2008),
- b) operate within a structured framework, be applied by all sectors of society, function within the prevailing policy and legal paradigm, operate within existing and new initiatives at all levels of decision making and sectors (Pope, Annandale et al. 2004).
- c) be consistent with the needs of the stakeholders, their expectations and practical applications, possess relevant desired features of sustainability assessments (be

integrated and predictive, cover inter and intra-generational distribution effects, acknowledge uncertainties and be participatory), be aligned with a chosen acceptability criterion (such as minimising unsustainable outcomes, maximising sustainable ones or leaving society to define and assess against defined notion of sustainability) (Gasparatos, Scolobig 2012),

- d) recognise the need for continual reflection onto original objective of the assessment as well as the probable policy controversies that would emerge, while applying an appropriate framing so as to tackle such controversies (Bond, Morrison-Saunders 2011).

While it would be difficult to frame an assessment methodology for assessing SD impacts of NAMAs that would be an exact fit for all the desired characteristics outlined above, one could posit for a tool that maximises comprehensiveness, integrated-ness, and strategic-ness, while operating within existing institutional, legal and policy frameworks and favouring a democratic discourse.

The Bellagio Principles (IISD 1996), which comprise of a stepwise, cradle-to-grave approach in the form of guidelines towards undertaking sustainability assessments, as well as their proposed review undertaken by (Pintér, Hardi et al. 2012), could be relevant in determining the right methodology towards assessing sustainability of NAMAs.

Since assessing sustainability perspectives can only make sense if they are actually gauged, the following section will discuss the different aspects to consider in assessing sustainability through indicators.

2.8 Sustainability indicators

The common adage of "what cannot be measured cannot be managed" has been floating within management circles for quite some time. The underlying logic behind it is rather convincing – that only through undertaking monitoring that progress or digress towards achieving set goals can be gauged and appropriate actions be taken. On top of aiding in decision making and management (Commission on the Measurement of Economic Performance and Social Progress, Stiglitz et al. 2009), measuring sustainable development impacts can also help in promoting advocacy, enhancing participation and consensus building, as well as boosting research and analysis (Parris, Kates 2003). In this context, the use of indicators is tuned towards accounting for an activity to be recognised as a NAMA that fits into broader sustainable development objectives.

Previous research on sustainability indicators have evolved from an initial focus on conceptual debates about the actual meaning of sustainable development and the possibility to produce indicators, followed by a concern for the creation of optimum models and methods to frame optimal indicators, towards a niche research area that views sustainability indicators as policy tools and part of governance discourses (Mineur 2007). It is within the last category that research onto assessing NAMA impacts can be positioned. However, whether geared towards a policy-, a target- or a project-based NAMA, not all aspects of sustainability can be quantified. There are some aspects, especially those that have an attached value component that can only be judged qualitatively and thus will imply a dose of subjective judgement. Furthermore, there is broad consensus that MRV mechanisms within NAMAs need to be simple while allowing for an element of freedom to pinpoint the sustainable development benefits. On basis of analysis pilot projects, (Jung, Eisbrenner et al. 2010) identified 3 types of MRVs – those with direct effects (where MRV could be based on existing methods such as Modelling, Measurements, and proxies on the basis of data and emission factors), those with indirect effects (where MRV could focus on activities and outcomes), and those which can only be rated by its broader sustainable

development benefits (e.g. reduction of other pollutants, job creation, other social and economic effects).

However, factoring in qualitative assessments are not the only limitations in sustainability assessments. Poorly chosen indicators can thus also create serious malfunctions in socio-economic and ecological indicators (Meadows 1998). The common pitfalls in choosing indicators include;

- over-aggregation of information leading to results leading to incorrect interpretations (e.g. GDP),
- using only measurable/quantifiable data instead of other important data (e.g. forest cover instead of size, diversity and health of trees),
- wrongly framed conceptual model (e.g. price of oil as a proxy for oil reserves),
- deliberate falsification of data (e.g. using only selected time scales so that results show only positive outcomes),
- diversion of attention from personal experience (e.g. stock market progressing despite population getting poorer),
- overconfidence from decision makers (e.g. believing that right choice made when indicators are faulty),
- incompleteness (e.g. indicators are not the whole system and may miss some tangible and intangible specificities of a system).

To attend to the above pitfalls, (Meadows 1998) has streamlined the most desirable characteristics of good sustainability indicators as those that would be clear in value (no uncertainty on which direction is good or bad), clear in content (easily understandable with values that makes sense), compelling (suggestive of effective action), policy relevant (for all stakeholders), feasible (reasonable cost), sufficient (not too little nor too much details), timely (not too much delay), appropriate in scale (not over or under aggregated), democratic (people to participate in framing and use of indicators), supplementary (should include what people cannot monitor by themselves), participatory (include what people can measure by themselves), hierarchical (can go to details or highlights easily), physical (use physical units as far as possible), leading (so as to get time to react to it) and tentative (can be put for discussions and changed accordingly).

With a view to ease the selection process, (Ness, Urbel-Piirsalu et al. 2007) have classified the different tools have been developed to support the formulation of indicators for sustainability based on temporal (ex-post or ex-ante assessment), coverage (product or policy focus) and integrative (combination of economic, social and environmental systems) dimensions of sustainability. (Ness, Urbel-Piirsalu et al. 2007) argues for three distinct umbrellas, comprising of

- a) indicators, which are mostly quantitative measures representing level of development within a specific area (often at country level)
- b) product-related assessment tools, that mainly converts the flows related to the production and consumption of goods and services, and
- c) integrated assessments, which uses systems analysis approaches to analyse multi-disciplinary complex issues with a view to support decisions related to a policy or project within a given region (often having an ex-ante focus and often carried out in the form of scenarios).

Of particular relevance from the above study are those tools that can integrate nature-society systems, out of which, integrated assessment tools (comprising of tools such as conceptual

modelling, system dynamics, multi-criteria analysis, risk analysis, uncertainty analysis, vulnerability analysis, cost-benefit analysis and EU sustainability assessment), which can be used for policies and projects, bear the most promise in terms of applicability to NAMAs.

However, directly applying any of the tools would not suffice to assess the sustainability of NAMAs, since those tools are not integrated within any conceptualisation of sustainable development. Such a gap has been addressed by a number of scholars and international institutions through the use of indicator frameworks. A number of such frameworks, defined as "... conceptual structure based on sustainability principles and used to facilitate indicator selection, development, and interpretation..." (Wu, Wu 2012); p 72) have been identified in literature and categorised along Table 4.

Table 4: Indicator Frameworks (adapted from (United Nations 2007) and (Wu, Wu 2012))

No	Indicator Framework	Short description	Remarks
1	Pressure-State-Response (PSR) based	<p>PSR framework, which has been expanded to DPSIR (Driving Force – Pressure – State – Impacts – Response), is more generally used to develop environmentally oriented indicators.</p> <p>- Those indicators identify the causal relationships between the DPSIR spheres and are related to driving forces that impact SD and corresponding pressures exerted, causing changes in states, impacts and response measures required.</p>	<ul style="list-style-type: none"> • ambiguous classification of indicators into more than one dimension, • does not capture causalities and inter-linkages, and • does not adequately capture link between indicators and policy issues
2	Theme-based	<p>Indicators are organised across typically four dimensions representing SD as determined by their policy relevance (social, environment, economic and institutional), further split into 15 themes, which in turn are divided into 38 sub-themes, corresponding to 58 indicators.</p> <p>The theme-based methodology was reviewed in 2007 and ceased to categorise SD within the 4 pillars with a view to accommodate for the multi-dimensional character of SD. A new categorisation was recommended comprising of 14 themes (poverty, governance, health, education, demographics, natural hazards, atmosphere, land, oceans, seas and coasts, freshwater, biodiversity, economic development, global economic partnership, and consumption and production patterns), 44 sub-themes, 50 core indicators, and a total of 96 indicators.</p>	<ul style="list-style-type: none"> • ability to link indicators to policy processes and targets. • provide clear and direct message to decision-makers • ease communication and sensitisation with public • can enable monitoring of progress in attaining the objectives and goals stipulated in national sustainable development strategies. • flexible enough to adjust to new priorities and policy targets over time.
3	Capital-based	<p>Attempts to calculate national wealth as a function of the sum of and interaction among different kinds of capital (including financial capital, produced capital goods, natural, human, social and institutional capital).</p> <p>Capital-based frameworks requires that all forms of capital be expressed in common terms, usually in monetary terms and assumes substitution amongst different forms of capital</p>	<p>Pros:</p> <ul style="list-style-type: none"> • can be a powerful tool for decision making <p>Cons:</p> <ul style="list-style-type: none"> • difficulties in representing all forms of capital in monetary terms; • data availability issues • not all capitals can be substituted • does not consider intra-generational

			equity concerns within and across countries
4	Integrated Accounting	<p>Accounting framework that draws all indicators from a single database that allows for sectoral aggregation while using consistent classifications and definitions. The most popular form is the System of Integrated Environmental and Economic Accounting, which is linked to the standard system of national accounts, and comprises of four types of accounts;</p> <ul style="list-style-type: none"> • physical data on material and energy flows, • data on environmental management and environment-related transactions, • accounts of environmental assets, and • accounts of transactions and adjustments related to the impact of the economy on the environment. 	<p>Pros:</p> <ul style="list-style-type: none"> • provides full accounts of environmental and economic capitals and flows • can be used for policy analysis also • can complement capital-based frameworks and theme-based frameworks (from the use of a consistent database) <p>Cons:</p> <ul style="list-style-type: none"> • does not factor in the social and institutional aspects of sustainable development yet
5	Bossel's Orientor-based	<p>Consist of a systems-theoretical framework for developing indicators of sustainable development that is intended to provide a holistic and comprehensive conceptual structure to guide indicator development. Orientors represented as categories of key concerns, values or interests that “orient most of our decisions”, comprising of "Existence", "Effectiveness", "Freedom of action", "Security", "Adaptability", "Coexistence" and "Psychological needs" (relevant only for sentient beings).</p> <p>Satisfaction of those orientors is required for a system to achieve sustainability. They usually cannot be measured directly, but their states of fulfillment can be inferred from appropriate indicators.</p>	<ul style="list-style-type: none"> • Claims to capture sustainability across all spatial scales • Avoids the problems of incompleteness and double-counting common in ad-hoc methods of indicator selection • Orientor-based indicators are expected to capture the essential aspects of the vitality, performance, and sustainability of human–environmental systems.
6	Aggregated indicators	<p>Comprise of a combination of indicators to capture elements of sustainable development. these are primarily used for raising public awareness</p> <p>e.g. Ecological Footprint, Environmental Performance Index, Adjusted Net Savings, Genuine Progress Indicator</p>	<p>Pros:</p> <ul style="list-style-type: none"> • easy to communicate <p>Cons</p> <ul style="list-style-type: none"> • pictures a limited view of sustainable development

Applying the indicator frameworks in Table 4 to the proposed NAMA framework in Figure 1 and taking into consideration the relative advantages and disadvantages of each one into consideration, it can be argued that, though capital-based, integrated accounting and aggregated indicators could provide useful guidance on sustainability, their limited coverage of sustainable development dimensions could be a stumbling block towards agreeing onto a set methodology or sets of methodologies to assess the impacts of NAMAs. The PSR or DPSIR framework, though a popular tool, might not be appropriate in view of its limited ability to link indicators to policy issues. The theme-based methodology from the United Nations Commission for Sustainable Development and Bossel's proposed orientor framework could be promising avenues in assessing the sustainability impacts of NAMAs.

After having explored the major theoretical and conceptual ideas from sustainable development literature that could be applied to NAMAs, the following sections will review the studies that have explicitly related NAMAs and their SD linkages.

3.0 NAMAs/Sustainable Development linkages

3.1 Existing research on NAMAs and SD

The need to increase research on the linkages between sustainable development and climate change mitigation has been most notably highlighted by authors of the Fourth Assessment Report of the Inter-governmental Panel on Climate Change (Sathaye, Najam et al. 2007). The following challenges in assessing the impact of specific policies on greenhouse gas emissions, which would be relevant to policy NAMAs have thus been highlighted (*Ibid.*) –

- differentiating the effects of a wide array of measures encompassing policy packages,
- policies are only one of the many incentives that decision makers react to (command and control, government controlled emissions-producing sectors),
- indirect effects of policies are difficult to evaluate (e.g. rebound effect of energy efficiency measures),
- difficulties in baseline evaluation.

A review of practical applications towards methodological development into the SD arena which relates to climate change mitigation initiatives reveals an overwhelming number of sustainable assessment tools and methodologies ((Bond, Morrison-Saunders 2011, Olsen 2007) Musango, Brent 2011; Özdemir, Härdtlein et al. 2011; Gasparatos, Scolobig 2012, Huang, Yang 2012, Musango, Brent et al. 2012).

As a recently coined mechanism with no formal definition, peer-reviewed literature on NAMA *per se* is rather fragmented, the less so regarding its possible linkages with sustainable development. The review on such explicit NAMA/SD linkages has thus been expanded to different types of mitigation activities that most closely relate to main conceptual framings of NAMAs at the time of writing. Those are summarised in Table 5, followed by a brief description of the main methodologies employed, as well as their advantages and limitations.

Table 5: Peer-reviewed publications related to NAMA-SD linkages

No	Typology	Author(s)
1	SD-PAM related	Winkler, Howells et al. 2007, Winkler, Hoehne et al. 2008; Román 2012
2	Policy-framework based	Olsen (2013)
3	Co-benefits approach	Dubash, Raghunandan et al. (2013)
4	Mitigation Action	Garibaldi, Winkler et al. (2013)

Winkler, Howells et al. (2007) have proposed to adapt the use of a system of indicators of sustainable development to SD-PAMs based on MARKAL - an energy modelling framework. The implications on annual energy saving, costs (savings, avoided investment in power

stations), pollutants (carbon dioxide, oxides of nitrogen, sulphur dioxide, total suspended solids), water savings and jobs (additional jobs created) of implementing a policy scenario, through a series of policy measures, and derived from South Africa's energy efficiency target are explored and projected as compared to a reference case.

Winkler, Hoehne et al. (2008) have explored the means to operationalize sustainable development policies and measures (SD-PAMs) – a precursor to NAMAs within a multilateral climate regime using four methods to quantify the benefits of SD-PAMs; case studies, national energy modelling, analysis of sectoral data and using global emissions allocation models. The comparative advantages and loopholes of each methodology are summarised in Table 6;

Table 6: Comparison of methodologies to assess SD impacts of SD-PAMs, adapted from Winkler, Hoehne et al. 2008)

No.	Methodology proposed	Strengths	Weaknesses
1	Case studies	<ul style="list-style-type: none"> • detailed example of SD-PAMs • operationalization within a specific context and national circumstances 	<ul style="list-style-type: none"> • results not very comparable across countries – need general guidelines
2	National energy modelling	<ul style="list-style-type: none"> • provides a link to energy policy and planning • capable of providing an overview of emissions from fuel combustion 	<ul style="list-style-type: none"> • no comparable method for Land Use, Land Use Change and Forestry available
3	Analysis of sectoral data	<ul style="list-style-type: none"> • allows comparable studies of energy and GHG intensity across countries • combines detailed analysis of the national level for sectors with international projections 	<ul style="list-style-type: none"> • setting up comparable indices limits the extent of accounting for national circumstances
4	Inclusion of policies in global emission allocation models	<ul style="list-style-type: none"> • provides a comprehensive overview of implications of SD-PAMs 	<ul style="list-style-type: none"> • limited data availability to represent national policies and measures in enough detail.

Román (2012) has utilised intervention theory to guide empirical studies onto the application of SD-PAM mechanism to selected mitigation case studies in Brazil and China and an adaptation project in Mozambique, with the goal of identifying favourable conditions whereby development policies can drive climate change actions. Román (2012) has furthermore stressed onto particular challenges related to MRV of SD-PAMs related towards establishing baseline criteria for greenhouse gas emissions, time-scales for mitigation, additionality definition and criteria for assessing sustainability.

Olsen (2013) has also analysed the respective sustainable objectives of policy frameworks of existing and emerging mechanisms for mitigation actions comprising of the Clean Development Mechanism, Low Carbon Development Strategies, NAMAs, Reducing Emissions from Deforestation and Forest Degradation Plus Conservation, New Market Mechanisms and Framework for Various Approaches, as well as their relative strengths and weaknesses. With a view to promote NAMA contribution to SD, Olsen (2013) has

recommended for a new integrated approach to assess the sustainable development co-benefits and transformational changes towards low carbon development that would consider SD objectives from the strategic planning and design stages, while incorporating stakeholder involvement and safeguards against negative impacts.

Dubash, Raghunandan et al. (2013) has explored a co-benefits approach towards prioritising climate change policy options in India. Using Multi-Criteria Decision Analysis (MCDA), policy options related to modal shift in urban transport, promotion of biofuels, and improved efficiency of domestic appliances have been gauged across four co-benefits outcomes identified from India's national strategic plan (comprising of economic growth, inclusion, local environment, and GHG mitigation). The likely impacts of policy options are then qualitatively described across a scale of 1 (strong negative impact) to 5 (strong positive impact) and represented as spider diagrams, pictured in Figure 4;

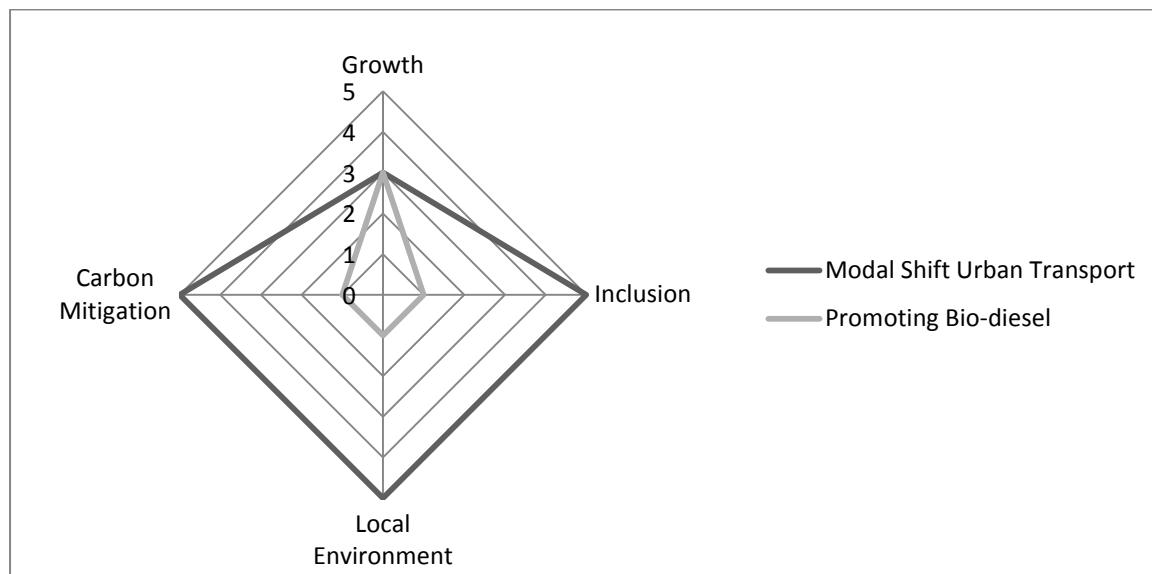


Figure 4: Likely SD impacts of policy measures in India, adapted from from Dubash, Raghunandan et al. 2013)

Dubash, Raghunandan et al. (2013) have also extended the MCDA to cover likely implementation issues across sub-dimensions of (a) political economy, (b) transaction and institutional costs, (c) cost per unit energy saved or provided, and (d) ease of financing. A similar qualitative scoring (1 to 5) was also undertaken and represented on spider diagrams. This type of analysis of allows an examination of the multiple strengths and weaknesses of a policy objective across multiple desired outcomes through debate, discussion and peer review. Though such a methodology does not assess the absolute effects of the policy measures, it enables a relative comparison of impacts across desired outcomes.

Garibaldi, Winkler et al. (2013) undertook a cross-country comparative analysis of mitigation actions undertaken in Brazil, Columbia, Chile, Peru and South Africa. They argue for flexibility in design of Mitigation Actions, hence also their MRV requirements, in view of the highly different policy environments and time horizons of interventions, while also stressing for a broadening of such an assessment to include Asian and more African states.

As mentioned in Table 5 and described above, the conceptual understanding of what constitute a NAMA, as well as approaches and methodologies employed to gauge the sustainable development impacts of NAMAs vary considerably. These can be described as early attempts towards methodological clarity on NAMA SD impact assessment. With NAMAs being currently developed bottom-up, such variances are also expected to occur. However, such wealth of concepts restricts cross-country comparisons, especially for

international NAMAs. Such comparisons would be particularly useful to the country-driven approach advocated by the Green Climate Fund (established at the 16th Conference of Parties to the UNFCCC and which could become one of the major institutions in future climate financing, (Green Climate Fund 2013)) and other donor communities, in easing the setting up of fair and transparent mechanisms for financing NAMAs in the developing world. To this end, the needs for more harmonised and integrated assessment approaches, embedded within documented conceptualisations of sustainability for each NAMA, are heightened. Such a structured approach can, moreover, bring more credibility to the overall NAMA process.

3.2 NAMA-SD future avenues

Attempting to delineate what is meant by sustainable development invariably leads to fundamental questions on what is to be sustained, what is to be developed, the extent to which sustainability is to be reached, the complex inter-linkages amongst spheres of sustainability, as well as the time horizon within which sustainability is being viewed. In the case of NAMAs, the driving motive that would crystallise such a mitigation measure will primarily be the development objectives to be sustained and developed, of a particular nationally elected administration within a particular country, operating at a certain point in time, at a particular level of development and within a socio-economic and cultural context – referred to as the national circumstances. With national circumstances expected to vary as much as there are countries proposing NAMAs, the likelihood of having commonalities in describing sustainable development could be very low. Moreover, the range of diversity in contexts is not the only issue in this case.

In a study of twelve efforts towards characterising and measuring sustainable development, Parris, Kates (2003) reveal that

- with a view towards being inclusive, an extraordinary broad list of items to be sustained and developed can be identified. That could be explained by both the vagueness of the concept and specifics of individual characterisation and measurement efforts.
- few efforts are explicit about the time frame of sustainable development, with a clear bias towards the present or near term, or at most, picturing a single generation (15 – 25 years)
- most initiatives are deductive, with the choice of indicators being guided on the basis of first principles or negotiated consensus of definitions of sustainability.

Robinson (2004) further suggest that for sustainable development to be meaningful,

- it should be considered as an integrative concept across fields, sectors and scales,
- since fundamental divisions will prevent the creation of a single coherent conceptual approach, stakeholders should shift from those attempts to conceptualise it towards more concrete actions,
- one should move beyond technical fixes towards addressing deep issues of opportunity, distribution, material needs, consumption and empowerment,
- scientific analysis, which embeds value judgements and social commitments, can only inform, rather than resolve issues about sustainability,
- "it should be part of an incremental process of collective decision making that is based on, but not determined by, expert knowledge; that is open to multiple perspective but not paralyzed by them; that allows for, and reinforces, social learning and changes in views over time; and that is provisional but concrete"

However, as mentioned in Sathaye, Najam et al. (2007), despite criticisms, some commonly held principles of sustainable development are emerging. These include the welfare of future generations, the maintenance of essential biophysical life support systems, ecosystem

wellbeing, more universal participation in development processes and decision making, and the achievement of an acceptable standard of human well-being.

The Millennium Development Goals, whereby nations pledged towards eight time-bound goals and targets to be achieved by the year 2015 using a baseline of 1990 is an example that it is possible to have, *ad minima*, some universal concepts of sustainability with significant progress reported across the different MDGs as at 2013 (United Nations Dept. of Public Information 2013) though with uneven achievements across countries (United Nations 2013). The outcome of the Rio+20 conference process whereby member states agreed to pursue a "green economy " agenda as well as develop a set of Sustainable Development Goals by 2015 (United Nations General Assembly 2012).could thus provide the basis of assessing cross-country NAMA sustainability (Linnér, Pahuja 2012 in Linner, Mickwitz et al. 2012).

4.0 Conclusions and Remarks

From a starting point of literature related to sustainable development assessments, the present paper has attempted to unpack the theoretical requirements that could better inform an integrated approach towards gauging the sustainable development benefits of NAMAs. A number of conclusions can be drawn based on the review undertaken.

Assessment of the SD impacts of NAMAs will be eased by adopting a sectoral focus, whereby oversight and operational control, especially regarding MRV requirements, is maximised under a sectoral or ministerial "one-stop-shop". The paper has proposed a NAMA framework to this intent, that further categorises NAMAs across the nature of intervention aimed (i.e. across policy-, target or project themes) and further classified within domestic, international and credited NAMAs.

A review of the explicit linkages between NAMAs and SD has shown that a wide variety of approaches and methodologies has been adopted by scholars, which is an indication for early attempts to provide clarity regarding assessing SD impacts of NAMAs. However, such an array of concepts restricts cross-country comparisons. On the other hand, imposing universal sustainable development assessment methodologies will incur the critique voiced by developing parties regarding the possible impingement to sovereignty. To attend to this concern, and considering the wealth of mind-maps and approaches towards assessing sustainability revealed within the review of SD literature, it would make sense to leave each developing country Party to define its own vision of sustainable development for each NAMA submitted. However, a minimum of common features should prevail, especially for NAMAs that require international funding, while leaving room for flexibility to accommodate for particular national circumstances. Those minimum features could provide the foundations for cross-country comparison of SD impacts for NAMAs. Inspiration in their conceptualisation could be obtained from the United Nations Sustainable Development Goals, the discussions of which are due to converge towards finalisation by 2015.

When going down to an individual country level, framing sustainable development will require combining views from stakeholders with sometimes radically different values, contribution from varying disciplines and sectors, considerations for different time-frames and agendas, amongst others. The literature review points towards the use of holistic approaches in defining visions and means to achieve sustainability, which provide for a systematic involvement of stakeholders. Countries could thus favour a democratic discourse to attend to those expected multiple and conflicting viewpoints, while being explicitly informed of the relative strengths and weaknesses of the different approaches that could be chosen. The use of Multi-Criteria Analysis has been found as a plausible option which could attend to such a concern, especially through promoting consensus building amongst stakeholders.

As one of the most common representations of sustainability, pillar-based descriptions, especially triple-bottom line (TBL) assessments, are probable choices that could be made by countries in defining their visions of sustainable development. When applied towards assessing NAMAs, the adoption of TBL approaches should be geared towards favouring a balanced strong sustainability perspective as opposed to a weak one. For methodological clarity and transparency, the limitations of such pillar-based descriptions should also be explicitly recognised.

The requirements for NAMAs to incur transformational change, which has been flagged in climate negotiations as an indication that NAMAs should contribute significantly to global mitigation, could be integrated within the respective conceptualisations of sustainability adopted by individual NAMA participating countries. However, as is the case for sustainability, this will require further clarity on what transformational change actually means

and how sustainable development, as an overriding paradigm, could be framed in such a way as to be conducive towards the transformation of sectors within which NAMAs operate. Further exploration of the SD literature as applied to NAMAs has revealed that such sustainability assessments will require a combination of ex-ante and ex-post assessments. Gauging the potential SD impacts of NAMAs in a first phase will help in their prioritisation, while assessing their actual SD impacts through ex-post assessments will allow decision making such that deviations from a chosen sustainability path can be rectified accordingly. To support the process, it would be essential to set up appropriate corresponding administrative and institutional arrangements, such as "NAMA Impact Assessments", which stands to gain from existing Environmental Impact Assessment licence processing setups. Those setups could also be expanded to cater for an extended verification system from a donor country or institution in the case of externally funded NAMAs.

Furthermore, the review has revealed a wide array of characteristics that sustainability assessments should possess. Those include considerations for such assessments to be comprehensive, integrated and strategic, while operating within existing institutional, legal and policy frameworks. However, from a pragmatic point of view, an exact fit for all those properties might not be realistic. Hence, attempting to maximise those desired properties would be advisable. To attend to those concerns, the adoption of the Bellagio Principles as a guidance towards indicator framing is a plausible option.

An analysis of existing sustainable development indicator frameworks has also shown that further inspiration could be taken from the United Nations Commission for Sustainable Development's theme based methodology and Bossel's orientor framework. However, such frameworks do not preclude the right for any country to develop its own framework, which would then need to be analysed for methodological sense by a potential new Methodological Panel for NAMAs similar to CDM or by an independent third party.

Furthermore, the above remarks calls for a "process" line of thought that shifts sustainability assessments away from a rigid and pragmatic debate towards a more deliberative sustainability discourse. This perspective has been highlighted by members of the Green Climate Fund, who have recommended developing countries to develop co-benefits as a process-based approach rather than an outcome requirement (Green Climate Fund 2013). However, as highlighted by Mineur (2007), there is also the risk of efficiency driven processes being favoured in lieu of a more democratic rhetoric, with participation being envisaged at most in its softer form through wide stakeholders being informed ex-post or through invitations to attend meetings due to extended trust expressed by politicians to expert knowledge and difficulties viewed onto the involvement of the public.

In line with the arguments raised in the present paper and with a view to further clarify NAMA-SD linkages, a number of research avenues could be pursued, such as comparing similar assessment approaches across different technologies operating within the same sector, across sectors, and across different developing countries as well as exploring theoretical considerations while applying different policy evaluation approaches. Further research is also required towards conceptualising transformational change as a new development paradigm that could combine enhanced sustainable development with a significant decrease in greenhouse gas emissions.

Bibliography

- BAKKER, S. and HUIZENGA, C., 2010. Making climate instruments work for sustainable transport in developing countries, *Natural Resources Forum* 2010, Wiley Online Library, pp. 314-326.
- BEBBINGTON, J., BROWN, J. and FRAME, B., 2007. Accounting technologies and sustainability assessment models. *Ecological Economics*, **61**(2), pp. 224-236.
- BERNSTEIN, L., BOSCH, P., CANZIANI, O., CHEN, Z., CHRIST, R. and DAVIDSON, O., 2007. Climate change 2007: synthesis report. Summary for policymakers.
- BOND, A.J. and MORRISON-SAUNDERS, A., 2011. Re-evaluating sustainability assessment: aligning the vision and the practice. *Environmental Impact Assessment Review*, **31**(1), pp. 1-7.
- BOSSEL, H., 2003. Assessing viability and sustainability: a systems-based approach for deriving comprehensive indicator sets. *Integrated natural resource management [electronic resource]: linking productivity, the environment, and development*, , pp. 247.
- BOSSEL, H., 1999. *Indicators for sustainable development: theory, method, applications*. International Institute for Sustainable Development Winnipeg, Canada.
- BRADLEY, R., BAUMERT, K.A. and DUBASH, N.K., 2005. *Growing in the greenhouse: Protecting the climate by putting development first*. World Resources Institute Washington, DC.
- BRUNDTLAND, G., 1987. Our common future: Report of the 1987 World Commission on Environment and Development.
- COMMISSION ON THE MEASUREMENT OF ECONOMIC PERFORMANCE AND SOCIAL PROGRESS, STIGLITZ, J.E., SEN, A. and FITOUSSI, J., 2009. Report by the commission on the measurement of economic performance and social progress.
- CONNELLY, S., 2007. Mapping sustainable development as a contested concept. *Local Environment*, **12**(3), pp. 259-278.
- DALY, H.E., 1993. 14 Sustainable Growth: An Impossibility Theorem. *Valuing the earth: Economics, ecology, ethics*, , pp. 267.
- DUBASH, K.N., RAGHUNANDAN, D., SANT, G. and SREENIVAS, A., 2013. Indian Climate Change Policy: Exploring a Co-Benefits Based Approach. *Economic & Political Weekly*, **48**(22), pp. 47-61.
- ESTES, R.J., 2004. *Toward sustainable development: From theory to praxis*, .
- GALLEGO CARRERA, D. and MACK, A., 2010. Sustainability assessment of energy technologies via social indicators: Results of a survey among European energy experts. *Energy Policy*, **38**(2), pp. 1030-1039.
- GARIBALDI, J.A., WINKLER, H., LA ROVERE, E.L., CADENA, A., PALMA, R., SANHUEZA, J.E., TYLER, E. and TORRES GUNFAUS, M., 2013. Comparative analysis of five case

studies: commonalities and differences in approaches to mitigation actions in five developing countries. *Climate and Development*, (ahead-of-print), pp. 1-12.

GASPARATOS, A. and SCOLOBIG, A., 2012. Choosing the most appropriate sustainability assessment tool. *Ecological Economics*, **80**, pp. 1-7.

GASPARATOS, A., 2010. Embedded value systems in sustainability assessment tools and their implications. *Journal of environmental management*, **91**(8), pp. 1613-1622.

GIBSON, R.B., 2001. *Specification of sustainability-based environmental assessment decision criteria and implications for determining "significance" in environmental assessment*, .

GLASER, M., 2006. The social dimension in ecosystem management: strengths and weaknesses of human-nature mind maps. *Human Ecology Review*, **13**(2), pp. 122.

GREEN CLIMATE FUND, 2013. *Business Model Framework: Objectives, Results and Performance Indicators*. GCF/B.04/03. Bonn, Germany: Interim Secretariat of the Green Climate Fund.

HACKING, T. and GUTHRIE, P., 2008. A framework for clarifying the meaning of Triple Bottom-Line, Integrated, and Sustainability Assessment. *Environmental Impact Assessment Review*, **28**(2), pp. 73-89.

HEUBERGER, R., BRENT, A., SANTOS, L., SUTTER, C. and IMBODEN, D., 2007. CDM projects under the Kyoto protocol: A methodology for sustainability assessment—Experiences from South Africa and Uruguay. *Environment, Development and Sustainability*, **9**(1), pp. 33-48.

HINOSTROZA, M.L., LÜTKEN, S., AALDERS, E., PRETLOVE, B., PETERS, N. and OLSEN, K.H., 2012. *Measuring, Reporting, Verifying. A Primer on MRV for Nationally Appropriate Mitigation Actions*. UNEP Risø Centre.

HOPWOOD, B., MELLOR, M. and O'BRIEN, G., 2005. Sustainable development: mapping different approaches. *Sustainable Development*, **13**(1), pp. 38-52.

HUANG, B. and YANG, H., 2012. Sustainability assessment of low carbon technologies--case study of the building sector in China. *Journal of Cleaner Production*, .

HUQ, S., 2002. Applying sustainable development criteria to CDM projects: PCF experience. *PCFplus Report*, **10**.

IISD, 1996-last update, Bellagio Principles [Homepage of International Institute for Sustainable Development], [Online]. Available: http://www.iisd.org/measure/principles/progress/bellagio_full.asp [10/8, 2013].

INTERNATIONAL NAMA FACILITY, 15 May 2013, 2013-last update, General Information Document. Available: [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/199043/NAMA_Facility - Information Document 14May2013_final.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/199043/NAMA_Facility_-_Information_Document_14May2013_final.pdf) [10/09, 2013].

JUNG, M., EISBRENNER, K. and HÖHNE, N., 2010. How to get Nationally Appropriate Mitigation Actions [NAMAs] to work. *ECOFYS Policy Update*, (11.2010),.

- KIM, J.A., 2003. Sustainable development and the CDM: A South African case study. *Tyndall Centre for Climate Change Research*, , pp. 1-18.
- LELE, S.M., 1991. Sustainable development: a critical review. *World Development*, **19**(6), pp. 607-621.
- LINNÉR, B. and PAHUJA, N., 2012. A registry of nationally appropriate mitigation actions: Goals, outcomes, and institutional requisites. *Ambio*, **41**(1), pp. 56-67.
- LINNER, B., MICKWITZ, P. and ROMAN, M., 2012. Reducing greenhouse gas emissions through development policies: a framework for analysing policy interventions. *CLIMATE AND DEVELOPMENT*, **4**(3), pp. 175-186.
- LÜTKEN, S., FENHANN, J.V., HINOSTROZA, M.L., SHARMA, S. and OLSEN, K.H., 2011. *Low Carbon Development Strategies: A Primer on Framing Nationally Appropriate Mitigation Actions (NAMAs) in Developing Countries*. Danmarks Tekniske Universitet, Risø Nationallaboratoriet for Bæredygtig Energi.
- MEADOWS, D.H., 1998. *Indicators and information systems for sustainable development*. Sustainability Institute Hartland.
- MEADOWS, D.H., MEADOWS, D.H., RANDERS, J. and BEHRENS III, W.W., 1972. *The Limits to Growth: A Report to The Club of Rome (1972)*. Universe Books, New York.
- MESAROVIC, M. and PESTEL, E., 1974. Mankind at the turning point. The second report to the Club of Rome.
- MINEUR, E., 2007. *Towards Sustainable Development: Indicators as a tool of local governance*, .
- MITCHAM, C., 1995. The concept of sustainable development: its origins and ambivalence. *Technology in Society*, **17**(3), pp. 311-326.
- MORTON, A., AIROLDI, M. and PHILLIPS, L.D., 2009. Nuclear risk management on stage: a decision analysis perspective on the UK's Committee on Radioactive Waste Management. *Risk analysis*, **29**(5), pp. 764-779.
- MUSANGO, J.K. and BRENT, A.C., 2011. A conceptual framework for energy technology sustainability assessment. *Energy for Sustainable Development*, **15**(1), pp. 84-91.
- MUSANGO, J.K., BRENT, A.C., AMIGUN, B., PRETORIUS, L. and MÜLLER, H., 2012. A system dynamics approach to technology sustainability assessment: The case of biodiesel developments in South Africa. *Technovation*, .
- NESS, B., URBEL-PIIRSALU, E., ANDERBERG, S. and OLSSON, L., 2007. Categorising tools for sustainability assessment. *Ecological Economics*, **60**(3), pp. 498-508.
- NESS, B., URBEL-PIIRSALU, E., ANDERBERG, S. and OLSSON, L., 2007. Categorising tools for sustainability assessment. *Ecological Economics*, **60**(3), pp. 498-508.
- NEUMAYER, E., 2003. *Weak versus strong sustainability: exploring the limits of two opposing paradigms*. Edward Elgar Publishing.

OKUBO, Y., HAYASHI, D. and MICHAELOWA, A., 2011. NAMA crediting: how to assess offsets from and additionality of policy-based mitigation actions in developing countries. *Greenhouse Gas Measurement and Management*, **1**(1), pp. 37-46.

OLSEN, K.H., 2013. *Perspective: NAMAs for Sustainable Development*. Volume 3 (4) and 4 (1) edn. The Energy and Resources Institute.

OLSEN, K.H., 2007. The clean development mechanism's contribution to sustainable development: a review of the literature. *Climatic Change*, **84**(1), pp. 59-73.

OLSEN, K.H., 2007. The clean development mechanism's contribution to sustainable development: a review of the literature. *Climatic Change*, **84**(1), pp. 59-73.

OLSEN, K.H., 2006. Why planned interventions for capacity development in the environment often fail: A critical review of mainstream approaches. *International Studies of Management & Organization*, , pp. 104-124.

OLSEN, K.H. and FENHANN, J., 2008. Sustainable development benefits of clean development mechanism projects: A new methodology for sustainability assessment based on text analysis of the project design documents submitted for validation. *Energy Policy*, **36**(8), pp. 2819-2830.

ÖZDEMİR, E.D., HÄRDITLEIN, M., JENSSEN, T., ZECH, D. and ELTROP, L., 2011. A confusion of tongues or the art of aggregating indicators—Reflections on four projective methodologies on sustainability measurement. *Renewable and Sustainable Energy Reviews*, **15**(5), pp. 2385-2396.

PARRIS, T.M. and KATES, R.W., 2003. Characterizing and measuring sustainable development. *Annual Review of environment and resources*, **28**(1), pp. 559-586.

PAWŁOWSKI, A., 2008. How many dimensions does sustainable development have? *Sustainable Development*, **16**(2), pp. 81-90.

PINTÉR, L., HARDI, P., MARTINUZZI, A. and HALL, J., 2012. Bellagio STAMP: Principles for sustainability assessment and measurement. *Ecological Indicators*, **17**, pp. 20-28.

POPE, J., ANNANDALE, D. and MORRISON-SAUNDERS, A., 2004. Conceptualising sustainability assessment. *Environmental Impact Assessment Review*, **24**(6), pp. 595-616.

REDCLIFT, M., 2005. Sustainable development (1987–2005): an oxymoron comes of age. *Sustainable Development*, **13**(4), pp. 212-227.

ROBINSON, J., 2004. Squaring the circle? Some thoughts on the idea of sustainable development. *Ecological Economics*, **48**(4), pp. 369-384.

ROMÁN, M., 2012. Introduction: SD-PAM and the potential of promoting climate action through development policies. *Climate and development*, **4**(3), pp. 167-174.

SATHAYE, J., NAJAM, A., COCKLIN, C., HELLER, T., LECOCQ, F., LLANES-REGUEIRO, J., PAN, J., PETSCHER-HELD, G., RAYNER, S., ROBINSON, J., SCHAEFFER, R., SOKONA, Y., SWART, R. and WINKLER, H., 2007. *Sustainable Development and Mitigation*. In *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Metz, B;

Davidson, O.R.; Bosch, P.R.; Dave, R.; Meyer, L.A. edn. Cambridge, United Kingdom and New York, USA: Cambridge University Press.

SCHMITZ, D., 2006. *Developing a methodology for assessing the sustainable development impact of small scale CDM hydropower projects*, .

SHARMA, S. and DESGAIN, D., 2013. *Understanding the Concept of Nationally Appropriate Mitigation Action*. Denmark: UNEP Risoe Centre.

SINGH, R.K., MURTY, H., GUPTA, S. and DIKSHIT, A., 2009. An overview of sustainability assessment methodologies. *Ecological Indicators*, **9**(2), pp. 189-212.

SUTTER, C. and PARREÑO, J.C., 2007. Does the current Clean Development Mechanism (CDM) deliver its sustainable development claim? An analysis of officially registered CDM projects. *Climatic Change*, **84**(1), pp. 75-90.

TYLER, E., BOYD, A., COETZEE, K., TORRES GUNFAUS, M. and WINKLER, H., 2013. Developing country perspectives on 'mitigation actions', 'NAMAs', and 'LCDS'. *Climate Policy*, (ahead-of-print), pp. 1-7.

UNEP, 2012. *The Emissions Gap Report 2012 - A UNEP Synthesis Report*. Nairobi: United Nations Environment Programme (UNEP).

UNFCCC, 2011. *Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010*. FCCC/CP/2010/7/Add.1. United Nations Framework Convention on Climate Change.

UNFCCC, 2008. *Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007*. FCCC/CP/2007/6Add.1. United Nations Framework Convention on Climate Change.

UNITED NATIONS, 2013. *Millennium Development Goals: 2013 Progress Chart*. United Nations.

UNITED NATIONS, 2007. *Indicators of Sustainable Development: Guidelines and Methodologies*.

UNITED NATIONS DEPT. OF PUBLIC INFORMATION, 2013. *Millenium Development Goals: Report 2013*. United Nations Publications.

UNITED NATIONS GENERAL ASSEMBLY, 2012. *United Nations General Assembly, 2012. A/RES/66/288. The future we want*, Rio: .

VAN TILBURG, X., RÖSER, F., HÄNSEL, G., CAMERON, L. and ESCALANTE, D., 2013. *Status Report on Nationally Appropriate Mitigation Actions (NAMAs)*.

VAN TILBURG, X., RÖSER, F., HÄNSEL, G., CAMERON, L. and ESCALANTE, D., 2012. *Status Report on Nationally Appropriate Mitigation Actions (NAMAs) Mid-year update May 2012*.

WINKLER, H., HOEHNE, N. and ELZEN, M.D., 2008. Methods for quantifying the benefits of sustainable development policies and measures (SD-PAMs). *Climate Policy*, **8**(2), pp. 119-134.

WINKLER, H., HOWELLS, M. and BAUMERT, K., 2007. Sustainable development policies and measures: institutional issues and electrical efficiency in South Africa. *Climate Policy*, 7(3), pp. 212-229.

WU, J. and WU, T., 2012. Sustainability indicators and indices: an overview. *Handbook of sustainable management*. Imperial College Press, London, , pp. 65-86.