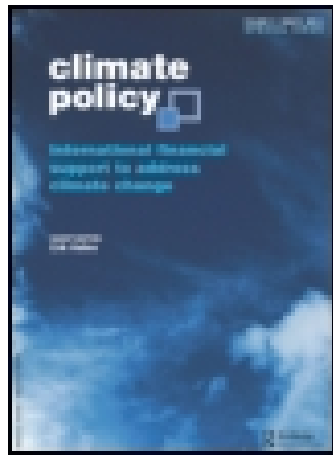


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Can CDM finance energy access in Least Developed Countries? Evidence from Tanzania

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■ research article

Can CDM finance energy access in Least Developed Countries? Evidence from Tanzania

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Policy documents and academic literature suggest that Clean Development Mechanism (CDM) finance could complement traditional 'energy access' (EA) funding in developing countries, including the Least Developed Countries (LDCs). Yet these propositions have not been empirically tested. This study helps fill this gap by examining constraints to CDM project passage through five stages of an idealized project development cycle (PDC) in Tanzania, and their implications for the ability of the CDM to contribute to financing energy access in LDCs. Twenty-five semi-structured interviews and documentary material were analysed using an analytical framework developed for systematic investigation of constraints. Institutional constraints such as the under-performance of Tanzania's Designated National Authority were the most often mentioned obstacles for project development. Yet non-institutional constraints such as limited energy sector mitigation potential, indigenous skill shortages, and low carbon market prices also hinder project development. Institutional constraints buttress, rather than supersede, pre-existing non-institutional constraints, and together they prevent energy projects from completing the PDC and accessing CDM finance. The number and severity of constraints suggest that the situation is unlikely to change rapidly, and that the CDM sustains and exacerbates existing global inequalities. Since traditional energy access funding is insufficient to address these inequalities, new funding and policy mechanisms are required.

Policy relevance

The CDM fails to fill the EA financing gap in Tanzania. This is also true for other LDCs where comparable project development challenges prevail. The CDM therefore appears to sustain uneven development patterns overlooking those most in need. Claims about its potential to enhance EA are misplaced, and the situation is unlikely to change rapidly. CDM and carbon market projects more widely will have limited ability to help financing EA in LDCs, even if the institutional setting within which they are implemented were reformed in the future. Yet traditional energy funding will be inadequate on its own. The debate over extending the CDM post-2017, when the second Kyoto Protocol commitment period expires, should be informed by honest appraisal of its merits and defects. Policy makers should revisit lessons provided by this article and wider research to help ensure that new EA mechanisms are not hampered by constraints and can benefit those most in need.

Keywords: Clean Development Mechanism; energy access; Least Developed Countries

1. Introduction

Policy documents and the academic literature suggest that climate finance transfers could complement traditional 'energy access' (EA) funding in Least Developed Countries (LDCs) (AEGCC, 2010; AfDB, 2010; Bhattacharyya, 2013; Gujba, Thorne, Mulugetta, Rai, & Sokona, 2012; UNFCCC, 2012; World Bank, 2013b). Carbon markets, and particularly the Clean Development Mechanism (CDM), are

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considered to have potential to do so (AEGCC, 2010; AfDB, 2010; UNFCCC, 2012; World Bank, 2013b), but little evidence actually exists about this potential. This article contributes to filling this gap by examining the constraints obstructing CDM finance from being used to enhance EA in Tanzania.

Like other LDCs, Tanzania performs poorly against the United Nations Development Programme (UNDP) Human Development Index (HDI) (UNDP, 2013a), has low per capita energy usage (World Bank, 2013a), and is acutely vulnerable to climatic shocks (Abson, Dougill, & Stringer, 2012; Maplecroft 2014). While much research has examined the development contribution of the CDM (Olsen, 2007), empirical insights from sub-Saharan Africa are scarce. This article expands the evidence base and draws lessons for future policy making.

No universally accepted EA definition exists (Sokona, Mulugetta, & Gujba, 2012). Here, it is defined as the ability to obtain adequate, clean, reliable, and affordable energy services to fulfil basic needs and enable productive usage (AEGCC, 2010). Energy services encompass electricity, fuels, and technologies for cooking and heating, and mechanical power (AEGCC, 2010). EA is crucial for fulfilling basic human needs such as health, education, communication, transport, and food security (Hailu, 2012; Sanchez, 2010). Yet over two billion people are without it (IEA, 2013). It can also reduce poverty by enabling productive activities (Hailu, 2012). EA is thus integral to human development, helping people to expand their freedoms and realize their capabilities (Sen, 2001). Countries' HDI performance is strongly correlated to per capita energy use (Sager, Oliver, & Chikkatur, 2006).

However, national and international energy policy discourses overlook EA, and a financing gap undermines its enhancement (Sanchez, 2010). Autonomous EA transitions can occur when the average daily income of people exceeds US\$3 (Sanchez, 2010). Yet, many living without EA earn less than \$1.25 per day (UNDP, 2013b). Energy poverty also prevents income growth (Glemarec, 2012). Enhancing EA thus requires the provision of financial assistance, yet those in energy poverty cannot command scarce public resources (EAC, 2008; Eberhard & Shkaratan, 2012). Foreign Direct Investment and development finance often bypass nations with the poorest EA (Gualberti, Bazilian, Haites, & de Graca Cravalho, 2012). The global economic downturn and donor apathy also undermine EA financing (Bhattacharyya, 2013; Glemarec, 2012). An injection of carbon market finance would therefore be welcome.

CDM aims to encourage sustainable development in developing nations and assist industrialized nations to achieve cost-effective emissions reductions (UNFCCC, 2013a). Project developers access CDM finance by selling Certified Emissions Reductions (CERs) to buyers in industrialized nations (Grubb, 2003). Projects must complete the CDM project development cycle (PDC) to attain CERs (UNFCCC, 2013e). CDM is not a silver bullet for EA financing, but several CDM projects have provided low-emission energy to host communities (UNFCCC, 2013f).

Developing nations generate a negligible fraction of global GHG emissions (EIA, 2012), but low-emission EA provision could yield development co-benefits. Increased trade and investment could foster economic growth (Sokona et al., 2012) while reducing the financial and political instability caused by volatile fossil fuel prices (Agbemabiese, Nkomo, & Sokona, 2012). Moving away from biomass consumption, an energy staple of the poor, would reduce health risks, particularly for women and children (Felix & Gheewala, 2011). Low-emission EA would reduce lock-in to emissions-intensive technologies, helping reduce the magnitude of future climate change (Gujba et al., 2012; Sokona et al., 2012). Championing low-emissions planning could imbue developing nations' calls for developed nations to reduce their emissions with enhanced moral weight (AfDB, 2008).

EA also has the potential to generate climate adaptation benefits. Coping with climatic risks is related to the abilities of people to fulfil basic needs (Eakin, Tompkins, Nelson, & Anderies, 2009), so improved EA could enhance adaptive capacity. Reduced biomass consumption would curtail deforestation and forest degradation, safeguarding important safety nets provided by forest resources (Hosonuma et al., 2012). Improved EA can also enable livelihood diversification and enhance people's productivity and income. EA transitions could thus enhance long-term climate resilience.

CDM-financed energy projects might therefore simultaneously foster development, mitigation, and adaptation efforts and be consistent with the notion of Climate-Compatible Development (CCD), which seeks to realize such 'triple-wins' (Mitchell and Maxwell, 2010). These projects are referred to in the following as 'climate-compatible energy access' (CCEA). Despite their triple-win potential, most CDM-CCEA projects are located in middle-income countries such as China, Brazil, and India rather than LDCs (UNEP-Risoe, 2013d).

Constraints to project development, which prevent access to CDM finance, differ among LDCs, but often include institutional constraints such as budgetary restrictions (Byigero, Clancy, & Skutsch, 2010), poor quality of regulation, and corruption (De Lopez, Tim, Iyadomi, Santos, & McIntosh, 2009; Sieghart, 2009). Common constraints also include underdeveloped private sectors (De Lopez et al., 2009), skills shortages (Sieghart, 2009), high transaction costs (Dhakal & Raut, 2010), poor access to financial products (Sieghart, 2009), limited local CDM awareness and experience, and lack of community buy-in (Gilau, Van Buskirk, & Small, 2007) because local benefits are absent (Mathur, Afonis, Paavola, Dougill, & Stringer, 2014).

High investment returns could alleviate the above-identified constraints. However, households and small businesses dominate LDCs' energy consumption. Together with underdeveloped industrial sectors this translates to low energy-sector emissions and mitigation potential (De Lopez et al., 2009). This reduces profitable project development opportunities (Jung, 2006). Low CER prices after the global carbon market price crash (Kossoy & Guigon, 2012) have exacerbated the problem. While opportunities for non-industrial, decentralized projects may still exist, high set-up costs make them hard to implement (Lewis, 2010). Yet the majority of LDC populations (UNFPA, 2011) live in hard-to-reach rural areas where decentralized projects are required to enhance EA.

Constraints of varying severity thus appear to frustrate CDM-CCEA project development in LDCs. Some constraints, such as low CDM awareness, seem more surmountable than others, such as insufficient mitigation potential. Concerns about inequitable global project distribution have led to CDM reforms such as 'bundling' and Programmes of Activities (UNFCCC, 2013b). UN-led CDM support programmes have also aimed to encourage project development (UNEP-Risoe, 2013b).

To date, CDM research has focused on a few types of constraint (e.g. economic, institutional, and technical constraints) and overlooked others (e.g. social and environmental constraints). Research has not examined whether the constraints together conspire to prevent project development and access to CDM finance. Addressing these literature gaps would enhance understanding of the constraints and aid practical interventions to overcome them. This article therefore examines constraints and their interactions to understand how they occur and vary in the different PDC stages and whether they influence the CDM's ability to help finance energy access.

In what follows, we outline a framework for the systematic analysis of the constraints obstructing CDM–CCEA project development. Constraints in Tanzania are examined using this framework. Findings are presented and discussed in relation to debates on the CDM, EA, and development, before conclusions and policy implications are drawn.

2. Case study, materials, and methods

2.1. Research context

Tanzania was selected as a case study for several reasons. In 2002 it ratified the Kyoto Protocol and is eligible for hosting CDM projects (UNFCCC, 2013c). Tanzanian GHG emissions were 0.02% of the global total in 2010 (EIA, 2012), but it is acutely vulnerable to climate impacts (Abson et al., 2012; Maplecroft, 2014). Most Tanzanians are also without EA (REA, No date) and face stark development challenges (UNDP, 2013a).

An Executive Board supervises the CDM and authorizes project registration (UNFCCC, 2013d). It operates under the guidance of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC). A Tanzanian Designated National Authority (DNA) assesses proposed projects against the country's Sustainability Criteria. DNAs should also build awareness about the CDM and coordinate national stakeholders (UNFCCC, 2013d). The Division of Environment within the Vice President's Office hosts Tanzania's DNA. It is assisted by a Steering Committee consisting of representatives of various Government Departments (DoE, 2007).

To achieve CERs, CDM projects must progress through PDC stages. A review of CDM governance literature (e.g. DoE, 2007; UNFCCC, 2013e) and interviews with Project Developers and Consultants suggest that five key stages can be distinguished:

- *Project identification.* Technical feasibility studies, profitability analyses, and other considerations help to determine project development opportunities. A Project Idea Note is produced to describe the planned project and its likely mitigation and sustainable development benefits. These must be 'additional' to business-as-usual scenarios.
- *Project design.* Project developers choose methodologies for determining project emission baselines and reductions, complete detailed Project Design Documents, and conduct stakeholder consultation with those affected by or interested in the project. Revised Project Design Documents must address stakeholder concerns.
- *Validation, approval and registration.* Projects are validated by Designated Operational Entities (independent third parties that evaluate projects against CDM regulations) before DNA approval and Executive Board registration.
- *Implementation.* Projects are implemented to achieve the objectives set out in the Project Idea Notes and Design Documents.
- *Monitoring and verification.* Emissions reductions are monitored using approved methodologies. Designated Operational Entities verify reductions and notify the Executive Board, which issues CERs.

The 'Mtoni Dumpsite' landfill gas recovery project – established in 2007 in Dar es Salaam to improve national electricity supply reliability – is the only Tanzanian CDM project to have ever received CERs

(1612 kCERs) (UNEP-Risoe, 2013d). Several other projects are currently progressing through the PDC stages. The Tanzanian Rural Energy Agency registered a Programme of Activities to enhance EA in May 2014 (UNFCCC, 2014). Further CDM projects involving biomass, hydro-electricity, biogas, energy efficiency, and wind and solar energy have been started but not completed (UNEP-Risoe, 2013c). Domestic and foreign actors including national, regional, and supranational governance personnel, NGOs and trade association employees, consultants, low-emissions energy technology distributors and project developers have been involved in the initiatives (UNEP-Risoe, 2013d). This project landscape suggests that project development challenges do exist and that the country offers a good case study for research.

2.2. Material collection and analysis

Semi-structured interviews were conducted with 25 stakeholder representatives (Table 1) in June 2013. They were identified using a snowball sampling approach (Atkinson & Flint, 2001). Information from UNEP-Risoe (2013a, 2013c) helped identify project developers as initial interviewees. They recommended wider stakeholders who were contacted for interview to expand the number and variety of respondents. Interviewees were asked about their involvement in CDM–CCEA projects and their experiences with project passage through PDC stages. Difficulties they had faced were probed. Interviews were recorded and transcribed.

The following documentary material was also collected and analysed: two Government policy documents (VPO, 2007, 2012), three Acts of Parliament (GoT, 2003, 2004, 2005), three documents detailing the content of UNEP-Risoe CDM support workshops (CEEST, 2007; Manyika, 2007; Muyungi, 2007), and the Government-produced *Handbook for CDM Activities in Tanzania* (DoE, 2007). The documents discuss CDM project development or contain information affecting the process.

A framework was developed to identify and analyse project development constraints in interview transcripts and documentary material (Figure 1). Moser and Ekstrom's (2010) approach for identifying constraints obstructing climate adaptation was used as a starting point. The framework focuses on project developers' capabilities to progress projects through PDC stages. Although in reality PDC progression may be messy and iterative, the framework facilitates linear analysis for convenience and

Table 1 Interviewees categorized by stakeholder group

Stakeholder group	Number of interviewees
Project Developer	7
Consultant	2
Low-emissions Energy Technology Distributors	4
National Government	3
Supranational Governance Organization	3
NGO	3
Trade Association	2
Donor Agency	1

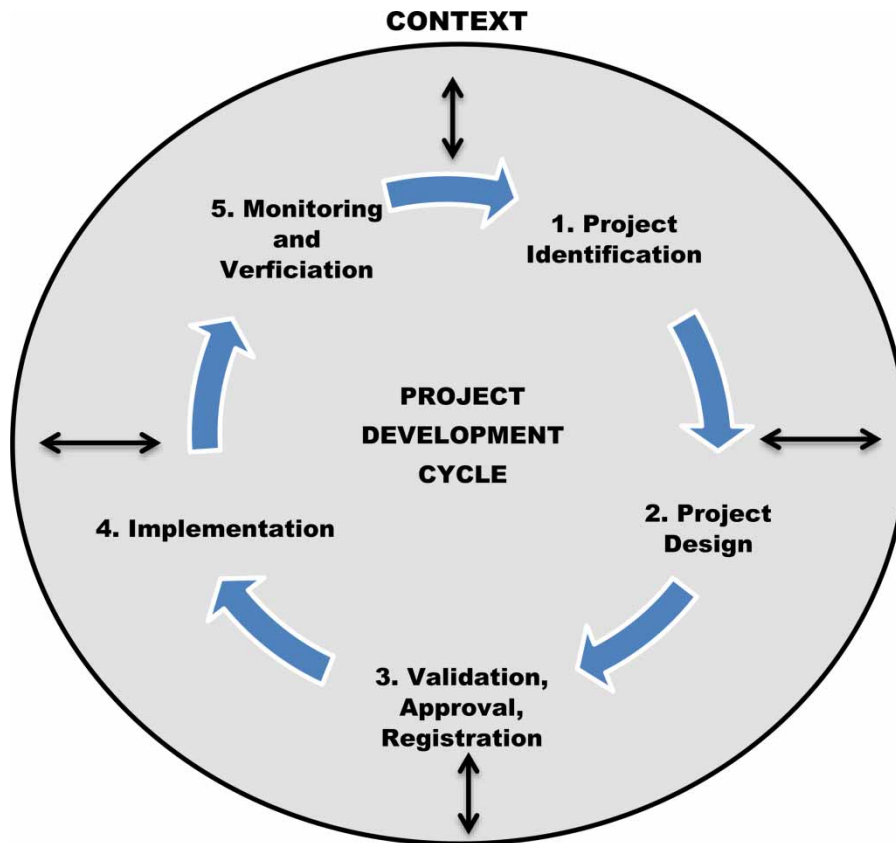


Figure 1 A diagnostic framework to guide the identification and analysis of possible constraints to CDM–CCEA project development

Notes: Blue arrows denote progression through PDC stages. Black arrows signpost the two-way relationship between project development and contextual factors.

clarity (Moser & Ekstrom, 2010). The framework aims to be both actor-centric and context-aware. Three interconnected factors shape CDM–CCEA project progression: project developers themselves, the social-ecological system upon which they act, and the larger governance context. Characteristics of, and interactions between, these elements determine the presence of constraints and reasons for their occurrence.

Evidence of constraints was identified using open coding. Constraints were categorized according to the PDC stage at which they occurred. An inductive approach (Glaser & Strauss, 1967) was used to group constraints according to their ‘types’ within PDC stages and establish contextual factors shaping their presence. Constant comparison techniques (Babbie, 2008) allowed interconnections between constraints to be established and themes arising from particular data sources to be validated. This process was continued until ‘theoretical saturation’ was achieved (Flick, 2009, p. 312).

3. Results

Institutional, economic, environmental, informational, technical, and social constraints to CDM–CCEA project development were identified in data analysis. Constraints were considered obstructive in their own right but were also linked to other constraints operating across the PDC. The most inhibitive constraints are discussed in the following in the order of the PDC stages. For confidentiality, interviewees are left anonymous. Only the stakeholder groups that interviewees represent are documented.

3.1. Project identification and design

Five interviewees suggested that project development opportunities are curtailed by limited industrial activity, dependence on kerosene and biomass, and low energy consumption. These translate to low GHG emissions from Tanzania’s energy sector. Project development is viable only in areas where energy production and consumption levels are comparatively high. One consultant highlighted that Tanzania’s sole accredited CDM project – the Mtoni Dumpsite project – is based in Dar es Salaam. EA is better there than elsewhere in the country, and large volumes of emissions-generating city waste are produced.

Low and unpredictable CER prices have made it hard to identify financially viable projects and complicate projects already under development. Half the interviewees identified CER prices as a constraint to project development but recognized that most other constraints outlined in this section predated the carbon market crash. A project developer considered that ‘the CDM was already dead prior to the crash’.

Seven interviewees stated that limited experience undermines Government assistance with project identification and design. They considered mitigation to be poorly understood by Government officials. One Government and one NGO employee suggested that ‘constantly changing’ CDM regulations and novelty of CDM policy design were a compounding factor. One Government employee considered CDM the first market-based environmental policy instrument in Tanzania.

National climate action focuses almost exclusively on adaptation in Tanzania. The National Climate Change Strategy (VPO, 2012) frames CDM–CCEA projects as mitigation exercises, overlooking their potential development and adaptation benefits (VPO, 2012). CDM is not mentioned in Tanzania’s National Adaptation Programme of Action (NAPA) (VPO, 2007). Failure to acknowledge their wider benefits may help explain low Government prioritization of CDM–CCEA projects.

Negative perceptions of the CDM among politicians and officials form a constraint to project development at the beginning of the PDC. Five interviewees, including two Government representatives, attributed this to low energy-sector emissions and carbon prices, which restrict project potential. Non-government interviewees also believed the Mtoni Dumpsite project underperformance to be a contributing factor.

A consultant, who has advised on the CDM across Africa, suggested that negative perceptions should be considered against Tanzania’s colonial past as well as global trade relations unfavourable to Africa. He talked of concerns that ‘foreign CDM project developers might buy vast tracts of land and undermine Tanzania’s struggle for independence’. Minutes of a UN-led CDM support workshop corroborate the view, with one participant worried that projects can be ‘lost to wazungu (white foreigners)’ (CEEST,

2007). Three non-government interviewees also suggested that Government employees regard biomass energy unfavourably as the 'poor man's fuel'.

A project developer and an NGO employee considered that limited Government enthusiasm contributes to coordination and governance problems within and across levels. It was seen to have contributed to a negative investment climate, which deters external CDM project investment. Curtailed enthusiasm was also considered to explain the Government's reluctance to commit resources to streamline CDM approval processes. Half of the interviewees considered CDM institutional and policy frameworks to be inadequate, and the roles and responsibilities for developing, implementing, and approving projects unclear. A supranational governance organization employee considered DNA to be built on unstructured, opaque, and 'ad-hoc' processes.

Despite these ambiguities, significant domestic involvement was considered necessary for DNA approval. The *Handbook for CDM Activities in Tanzania* states simply that 'there should be a partnership between the investor country company or institution and the host country local private company, NGO, research institution or Government department' (DoE, 2007, p. 14). Yet four non-government interviewees considered that projects must be over 51% domestically owned to be approved. One Government employee denied this. Another stressed that 'local involvement must be reasonable'. Regardless, the necessity for domestic involvement was considered by half the interviewees to have restricted project passage through the first and second PDC stages.

Nine interviewees reported that domestic technical skill shortages constrain the preparation of CDM documentation and the development of methodologies for measuring emissions reductions. Five respondents considered these tasks to be complicated by poor baseline data. Additional non-institutional constraints have hindered domestic ability to identify and capitalize on CDM opportunities. According to 10 interviewees, awareness of CDM and renewable energy solutions remains limited in Tanzania. An underdeveloped private sector, inexperience in dealing with market-based policy instruments, perceived slow pace of business, and lack of entrepreneurial spirit were also considered constraints. A disconnect exists between conditions on the ground and the domestic involvement requirement.

A UN-led CDM support programme sought to build domestic CDM capacity via stakeholder workshops (2006–2009). Three interviewees regarded it as a fruitful exercise, but one consultant considered that 'the workshops only involved a limited number of people'. A supranational governance organization employee believed the Government had overlooked lessons that had emerged.

Three interviewees believed that limited domestic expertise has increased the dependence on external consultants, accountants, and auditors. This has raised the transaction costs of regulatory compliance, with interviewees estimating these costs to total up to \$200,000 per project across the PDC. According to 11 interviewees, the funds cannot be sourced from domestic banks. Despite UN efforts to train financial institutions about CDM opportunities, banks were considered to be uninformed about, and wary of supporting, climate investments. CDM complexity and delays on investment returns caused by other constraints compound this wariness, according to two respondents. Tanzanian banks charge very high interest rates (up to 16% for loans of under five years). This was regarded as incompatible with CDM–CCEA project financing requirements.

Tanzania's Electricity Supply Company (TANESCO) is responsible for paying for electricity generated by grid-connected projects, but three project developers suggested that it regularly fails to fulfil its obligations. Negative bank perceptions about TANESCO's credibility as an end-client have further

restricted finance for affected projects. Poor access to finance and long investment return periods are also problematic for project developers. One project developer said that when working on CDM projects he ‘worries about what I will eat tomorrow’. He stated that the UNDP will provide developer loans of up to \$250,000 to cover upfront costs, but this funding is not accessible before the DNA has approved projects. This approval is difficult to obtain.

3.2. Validation, approval, and registration

Most Tanzanian CDM–CCEA projects fail at the Validation, Approval and Registration stage, yet reasons for this are unclear. According to one project developer, ‘Projects are blocked for no reasons. You are just stuck’. Two interviewees indicated that the aforementioned unstructured, ad hoc, and opaque CDM decision-making processes, and the vagueness of Tanzania’s Sustainability Criteria, make the identification of the reasons for project failure very difficult.

Respondents widely considered DNA project approval near impossible to attain. The approval process is characterized by delays and poor communication. Over half the interviewees perceived the DNA to be unresponsive. Accordingly, projects end up getting a *de facto* non-approval for unspecified reasons. Frustration about the situation also exists in the DNA’s office, but different views prevail over why gaining approval is so difficult.

Six interviewees, including a Government official, cited insufficient DNA staffing and resources as key explanatory factors. Another Government official suggested the same in a UN-led CDM support workshop presentation (Manyika, 2007). Several interviewees reported that international and domestic actors regularly complain to Government organizations about DNA underperformance. Continued complaints about the DNA fall upon deaf ears: indeed, a trade association employee felt ‘powerless to create change’. According to one donor agency employee, DNA underperformance has led most agencies to advise international investors to avoid Tanzania.

Some project developers suggested ‘corruption in the DNA’ as another cause for its underperformance. One said ‘staff are also CDM consultants and therefore have vested interests in seeing certain projects succeed and others fail’. Another, who has developed CDM projects in many non-industrialized nations, described the DNA as ‘the most corrupt in Africa’. A third suggested ‘corruption is a continental norm’. Yet two project developers and a consultant considered that non-approvals are down to the DNA’s gatekeeper role: projects are blocked for failing to meet Tanzania’s CDM Sustainability Criteria. An NGO employee explained that although ‘the DNA is seen as “Mr Bad Guy” who strangles Tanzania’ by blocking projects, its staff members work to protect citizens from harm. The same interviewee stated that Africa attracts profit-seeking ‘carbon cowboys’ who look to develop projects without regard for host communities.

3.3. Project implementation and monitoring and verification

Insufficient consumer demand was seen to constrain project implementation. While Tanzania’s electricity grid experiences supply problems, demand for off-grid electricity projects is curtailed by low disposable incomes and low-cost biomass abundance. Even CDM-subsidized CCEA solutions are prohibitively expensive for most local people. Interviewees mentioned that demand is further constrained by concerns about imported technology and associated job losses, low education and awareness about project benefits, and negative past experiences with energy products. Such factors weaken

community buy-in, which has hampered project developers' ability to stimulate emission reductions and make projects commercially viable. One project developer said project design changes introduced after initial stakeholder consultation often exacerbate disillusionment.

Few energy solutions were regarded to address local peoples' energy needs comprehensively. For example, electricity solutions provide lighting but may not fulfil cooking and productive usage requirements. Thus, local people are reluctant to spend money that could be used to purchase vital goods and services, such as food, clothing, and children's education. According to one energy technology distributor, 'solar provides light but does not cook food or give children clothes. It is complicated.'

Five interviewees suggested that domestic skill shortages restrict the manufacture, installation, and maintenance of required energy technologies, as well as project monitoring and verification. Skills shortages are most acute for decentralized rural projects. Despite Government efforts to encourage low-carbon energy generation by reducing renewable technology import duties, foreign exchange costs of importing products have increased implementation costs. Hiring external consultants for monitoring and verification further increases project development costs. TANESCO's inadequate tariffs, its unwillingness to assist with grid-infrastructure costs, and failures to pay project developers are also seen to burden grid-connected projects.

Our results are subject to the limitations of snowball sampling, which does not always yield representative output (Heckathorn, 2011). Here, it led to less representation for some stakeholder groups (e.g. Government, Donor Agencies) compared with others (e.g. Project Developers). Low Government representation may explain why institutional constraints were most frequently cited.

4. Discussion

The methodological approach developed and used in this article has enabled a comprehensive diagnosis of constraints to CDM–CCEA project development operating across the PDC. By incorporating contextual factors, the framework has fostered an understanding of why constraints occur and has captured their consequences, relative severity, and interconnections. Its use focused data collection efforts and allowed for comparison and amalgamation of data gathered from dissimilar sources. In the following we discuss our results with reference to wider debates on the CDM, EA, and development. Evidence suggests that the constraints facing Tanzania are also common for other LDCs. By contrast, higher-income developing countries have fewer constraints. It is therefore unsurprising that these countries have been the primary beneficiaries of CDM–CCEA projects to date (UNEP-Risoe, 2013d).

Institutional constraints are widespread in Tanzania, and include low levels of staffing, weak budgetary capacity, and alleged corruption within the DNA. These constraints are linked to the consequences of other institutional constraints operating at earlier PDC stages. Their combined impacts have prevented project progression. Changing and complex CDM regulations appear an important, but less acute, institutional constraint.

The literature emphasizes the importance of a well-functioning DNA for successful CDM project development (Byigero et al., 2010; Jung, 2006). The Tanzanian DNA was seen to have failed to meet the three key requirements for a DNA described by Winkler's, Davidson, & Mwakasonda (2005): investment promotion, administrative support, and the creation of clear approval (including National

Sustainability) criteria. This has had implications for non-institutional constraints, with poor DNA functioning linked to low baseline information availability, which has hindered project design.

Inadequate DNA staffing and financial capacity is also problematic in Rwanda, Uganda, and Malawi (Byigero et al., 2010; Stringer et al., 2012). By contrast, well-defined and engaged institutions, adequate capacity, and smooth approval procedures underpin the success of China, India, and South Africa in attracting CDM projects (Byigero et al., 2010; Phillips & Newell, 2013; Teng & Zhang, 2010). China and India rank first and second in terms of CERs accrued (UNEP-Risoe, 2013d). South Africa has received by far the most CERs in Africa (Byigero et al., 2010). However, difficult and protracted approval should not be constructed as a proxy for institutional weakness. In Brazil, stringent and sometimes cumbersome DNA processes are part of a rigorous scrutiny of National Sustainability criteria (UNIDO, 2003). The prioritization of investment over sustainable development can mean CDM projects fail to benefit host communities (Hultman, 2009). Commendable scrutiny may result in the non-approval of some projects. Yet in Tanzania and other LDCs, other issues are clearly involved.

Non-institutional constraints operating across the PDC also restrict CDM–CCEA project development. Low EA in Tanzania translates to a very limited energy sector mitigation potential, which in turn prevents projects from generating sufficient CERs to make them commercially viable. This has reportedly thwarted the majority of projects and has unevenly distributed project potential within the country. Low non-sink mitigation potential is challenging for the majority of countries eligible for CDM investment, including all African nations except South Africa (Jung, 2006). Globally, energy-sector CDM projects are often overlooked in favour of industrial gas capture projects, which yield greater commercial returns for mitigating GHGs with high radiative forcing values (Wara, 2007).

Significant indigenous involvement is considered necessary for project approval in Tanzania. Similar requirements exist elsewhere, including in China (Schroeder, 2009). Unlike in China, however, identifying and capitalizing on latent Tanzanian CDM–CCEA project development opportunities is undermined by indigenous skill shortages, low awareness of low-carbon energy solutions and policy, a slow pace of business, and limited entrepreneurial spirit. Low consumer demand also restricts project implementation. Ahlborg and Hammar (2012) identified these constraints when analysing the potential for renewable energy rollout in Tanzania. They hamper CCEA project development in other lower-income developing countries, both when project funding involves CDM finance and when it does not (Simon, Bumpus, & Mann, 2012).

The CER price collapse was identified as the nail in the coffin for CDM–CCEA project development in Tanzania. This was caused by global economic volatility and chronic oversupply in the global carbon market's 'engine', the EU Emissions Trading Scheme (Kossoy & Guigon, 2012, p. 9). Prices have slumped to under €1 (Point Carbon, 2012), and only projects with very high mitigation potential are now viable. This has diminished project development opportunities worldwide, including in China (Teng & Zhang, 2010).

Nonetheless, the aforementioned constraints predated the carbon market crash and were already hindering LDC project development. Their presence also contributes to financial obstacles. For example, in Tanzania, indigenous skill shortages require external assistance, which significantly increases transaction costs. The absence of domestic manufacturing capacity also inflates import costs (Painuly & Fenhann, 2002). Even before the carbon market crash, CDM finance increased the rates of return only marginally, and projects needed to be near to financial closure without CDM to be viable (Schroeder, 2009). LDCs suffer from heightened project development costs, poor investment

climates, and inadequate access to financial products (De Lopez et al., 2009; Sieghart, 2009). Nearing financial closure is therefore more testing than in higher-income developing countries.

The size and type of a project makes little difference in Tanzania to its viability, which contradicts research findings in other LDCs (Beck & Martinot, 2004; Lewis, 2010). While constraints may differ depending on a project's characteristics, the difficulties of dealing with TANESCO and navigating infrastructural weakness mean that the obstructions reported for large, grid-connected projects were just as significant as those for small-scale, decentralized technologies.

Despite the more common identification of institutional constraints by interviewees and documentary material, environmental, technical, social, and economic constraints play an equally important role in hindering project development. Resolving the institutional constraints would not be sufficient for the CDM to enhance EA in Tanzania and other LDCs. Institutional constraints have merely buttressed pre-existing non-institutional constraints. Together, they have – to all practical purposes – halted CDM–CCEA project development. These findings explain the scarcity of Tanzanian voluntary carbon market projects (Markit, 2013), which do not require DNA approval, often benefit from flexible regulation (Schroeder, 2009), and are less exposed to institutional constraints.

Institutional and non-institutional constraints may be mutually reinforcing in LDCs. Curtailed Tanzanian Government enthusiasm for CDM projects is linked to a lack of project opportunities. This resonates with the conclusions of Byigero et al. (2010), who found that well-functioning institutional arrangements are only found in countries that benefit from project development opportunities and that are able to exploit them. An absence of the latter makes governments less willing to invest scarce resources in CDM institutional frameworks, in what is a 'chicken-and-egg' situation (Byigero et al., 2010, p. 188). This could explain why Tanzania's Government has so far ignored stakeholders' demands for wholesale DNA reform: it appears a rational response given the likely limited payback.

However, limited Government enthusiasm is not only a result of the lack of project opportunities. Tanzanian energy policy and legislation acknowledge that most of the population will depend on biomass for the foreseeable future. However, policy instruments for encouraging interventions (e.g. improved cookstoves), which can help biomass consumption better meet people's energy needs, are absent (GoT 2003, 2005). Instead, transitions towards 'modern energy' technologies are emphasized. This may be because public authorities have a low regard for biomass. Negative perception and a lack of enabling environment are common across sub-Saharan Africa, undermining biomass energy sectors (Owen, van der Plas, & Sepp, 2013). DNA non-approval for CDM biomass projects may also be linked to negative perceptions.

The UN-led CDM support programme in Tanzania – established to facilitate project development – focused narrowly on DNA capacity-building, awareness-raising among financial institutions, and enhancing selected potential project developers' technical expertise by educating them about CDM administration. Tanzania has received 6.6% of all capacity-building funding allocated to Africa and LDCs (much more than most other eligible nations) (Okubo & Michaelowa, 2010), but the activities have failed to address constraints to CDM–CCEA project development.

Byigero et al. (2010) and Okubo and Michaelowa (2010) have identified similar patterns in support activities across LDCs. The former consider support programmes to be politically motivated, initiated merely to show that 'something is being done' to assist countries that CDM has not benefited. Programmes of Activities and 'bundling' reforms are yet to deliver in Tanzania. Interviewees largely welcomed them, but they have been insufficient to kick-start project development. Whether the

Programme of Activities registered in May 2014 by the Tanzanian Renewable Energy Agency can counter this trend remains to be seen.

5. Conclusion and policy implications

A poor 'fit' between policy design, UN-led support programmes, and Least Developed Country (LDC) implementation contexts means that Clean Development Mechanism– climate-compatible energy access (CDM–CCEA) beneficiaries tend to be higher-income developing countries (UNEP-Risoe, 2013d). These countries also receive traditional energy access (EA) funding (Bhattacharyya, 2013). The CDM values cost-effective CER generation potential, supportive business environments, and indigenous project development capacity (Niederberger & Saner, 2005), and is implemented across the developing world as a 'panaceum'. Research reported in this article found that several institutional, economic, environmental, informational, technical, and social constraints operate across PDC stages in Tanzania and create conditions counter to those valued by CDM.

Institutional constraints, including DNA underperformance, are important, but non-institutional constraints also restrict project development. Low energy-sector mitigation potential, indigenous skills shortages, and slumped carbon prices are particularly problematic. Institutional constraints have merely buttressed pre-existing non-institutional constraints. Together they have, to all practical purposes, halted CDM–CCEA project development. Constraints are also often found in other LDCs. It is therefore unsurprising that CDM–CCEA projects are more plentiful in higher-income developing nations, which face less onerous constraints.

Should commercially viable project development opportunities arise in LDCs, they must still compete with the 'low-hanging fruit' (Newell, 2012, p. 252) offered by CCEA and non-CCEA projects elsewhere. Non-LDC projects often benefit from superior initial conditions and are rationally prioritized by investors engaging in CDM's 'race to the bottom' (Newell, 2012, p. 251). Developmental problems underpinning constraints see countries classified as 'LDCs' in the first instance (UN, 2011). Accordingly, the CDM creates something of a paradox, whereby problems that CCEA investment could help solve also prevent its attainment.

The CDM is exacerbating, rather than reducing, global inequalities. Although the global commons may benefit from CDM mitigation in higher-income developing nations, the development and adaptation benefits of CCEA bypass LDC populations. Because many constraints predated the CDM in Tanzania, it is questionable whether it was ever adequately configured to finance EA there. Claims about CDM potential to enhance EA in LDCs are misplaced, and the situation is unlikely to change rapidly.

Targeting and overcoming the many onerous constraints would be challenging and complex. Although structural CDM reform has been discussed extensively, research suggests that proposed market-based options would fail to encourage project development in LDCs while underlying constraints persist. Replacing the current project focus with a sectoral CDM or creating preferential LDC access measures would be unlikely to yield benefits (Castro & Michaelowa, 2010; Murphy, Cosbey, & Drexhage, 2008). Given the low mitigation potential, neither is it clear that grants and loans for LDC project developers to ease the financial burden of constraints (HLPD, 2012) would sufficiently incentivize action. We therefore conclude that the CDM and carbon market projects more widely have only limited ability to help finance LDC EA.

The situation might change if the CDM were reformed to value sustainable development and/or adaptation benefits. However, this change would undermine its mitigation impact. In turn, it could reduce motivation for emissions-reduction within the United Nations Framework Convention on Climate Change (UNFCCC) more widely. This is because the CDM plays a key political role in uniting developed and developing countries behind future climate action (HLPCD, 2012). A fund-based CDM could make project distribution more equitable and overcome low carbon prices. Yet this would also be unlikely to generate the levels of finance required to enhance LDC EA and advance other mitigation activities (Murphy et al., 2008). Future generations in LDCs would be most detrimentally impacted should emissions-reduction efforts dwindle.

If CDM remains a market-based mechanism, then the misplaced claims of policy makers about its potential to enhance LDC EA must end. The debate over extending the CDM post-2017, when the second Kyoto Protocol commitment period expires, should be informed by honest appraisal of its merits and defects. Acknowledgement of the CDM's shortcomings could create leverage for UNFCCC fund-based mechanisms, such as the Adaptation Fund and Least Developed Countries Fund, to play an immediate compensatory role. The Green Climate Fund could also provide assistance in the longer term. However, new and innovative funding and policy mechanisms are also required to overcome traditional EA funding shortages. If policies encourage CCEA, they should be informed by empirical social justice analyses of projects past and present, since the justice implications of pursuing development, mitigation and adaptation for host populations are not yet clear. Policy makers should revisit lessons provided by this article and wider research to help ensure that new mechanisms are not hampered by constraints and can benefit those most in need.

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