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Integrating clean development mechanism into the development approval process of buildings: A case of urban housing in Uganda

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ABSTRACT

Since climate change is no respecter of geographical boundaries, concerted mitigating actions such as clean development mechanism (CDM), are desirable. In CDM, developed countries can earn certified emission reduction credits from emission reduction projects undertaken in developing countries. Recent research suggests that, theoretically, CDM can be extended to the building sector. However, there is limited research on how CDM can be integrated in the development approval process (DAP) of buildings. This paper presents an investigation on how CDM could be integrated into the DAP of buildings in urban Uganda. A method of process modelling was used to describe the existing DAP, and also to design a new DAP. To demonstrate how CDM could be integrated into the new DAP, a typical dwelling unit was used. Two options for the dwelling were considered: a baseline (i.e. constructed using typical materials, plant, and workforce) and alternative (i.e. constructed using provisions to reduce carbon emissions). The difference in emissions in the two options constituted the basis for a CDM. Results suggested that the existing DAP does not consider carbon accounting and thus was not congruent with CDM modalities. A new DAP which is compatible with CDM was proposed. When the CDM concept was integrated into the new DAP, a bottom-up projection regarding construction of 28,000 houses annually within the capital city showed that reductions of over 200 ktCO_2 could be achieved in a period of 10 years. These figures were comparable with prevailing CDM initiatives. The structure of a CDM programme aided by the new DAP was presented and discussed. This study shows that integrating CDM into the DAP of buildings in Uganda is possible if assessment of carbon emissions is incorporated in the existing DAP. The overall findings suggest that CDM could promote market-based mechanisms of enhancing sustainable construction in developing countries.

1. Introduction

Reducing greenhouse gas (GHG) emissions requires concerted efforts because climate change is everyone's problem. To this end, the concept of clean development mechanism (CDM) was conceived. CDM provides a global platform for developed and developing countries to offset emissions through emissions trading (Gillenwater & Seres, 2011). The emissions traded arise from emission reduction projects, such as afforestation, that are undertaken in developing countries. The aim of CDM, according to the Kyoto Protocol, is twofold; developed countries are enabled to meet their emission reduction targets whilst facilitating developing countries to achieve sustainable development. In that way, CDM emerges as a 'win–win' strategy for countries in jointly tackling climate change.

Recently, the building sector, which accounts for one-third of the annual global carbon emissions (Roodman & Lenssen, 1995; UNEP, 2009; WBCSD, 2012), has been identified as a potential beneficiary of CDM. In Zhou, Li, and Chiang (2013), CDM was identified as a viable solution to alleviate barriers impeding promotion of energy efficient buildings in China. Mok, Han, and Choi (2014) explored the potential of implementing CDM in the building sector and concluded that there are several emission reduction opportunities fit for CDM, albeit scattered along the lifecycle of building projects. Chen, Jiang, Dong, and Huang (2015) proposed a CDM energy performance based method to reduce transaction costs in implementing CDMs in China's building sector. Lam, Chan, Yu, Cam, and Yu (2015) explored the applicability of CDM in the

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Hong Kong building sector and identified some barriers and potential solutions. However, besides the paucity of CDMs related to buildings (Cheng, Pouffary, Svenningsen, & Callaway, 2008; Hinostroza et al., 2007; Novikova, Ürge-Vorsatz, & Liang, 2006), there are no studies yet to suggest how CDMs can be integrated in the development approval process of buildings, yet the greatest potential to reduce carbon emissions from a building is in decisions made in the earliest stages of its life cycle (BRE and Cyril Sweett, 2005; Goggins, Keane, & Kelly, 2010; Jowitt, Moir, Grenfell, & Johnson, 2012). This paper therefore investigates how the CDM can be integrated into the development approval process of buildings, with a focus on urban housing in Uganda.

2. Background

This section provides a brief background on the CDM concept and why this concept should be considered in addressing housing shortage in urban areas of Uganda.

2.1. The CDM concept

The CDM concept was established under the Kyoto Protocol (Article 12), an international treaty to reduce GHG emissions. Developed countries that are signatory to this protocol (i.e. Annex 1 countries) committed to reduce their GHG emissions. In the first commitment period (2008–2012), the countries committed to reducing their emissions by 5% of 1990 levels. The second commitment (2013–2020) stipulated reduction of emissions by 18% below those of 1990 (UNFCCC, 2013a). To provide flexible market-based mechanisms of meeting emissions reduction commitments, the CDM concept was introduced (Kyoto Protocol, Article 12). In CDM initiatives, the Annex 1 countries can purchase certified emissions reduction (CER) credits, each equivalent to one tonne of emissions avoided. The purchased CER credits can then be used to offset emission reduction targets. However, the CER credits must have been generated from emission reduction activities (e.g. planting of trees, renewable energy projects, energy efficiency measures etc.) undertaken in the participating developing countries (i.e. non-annex 1 countries) (Kyoto Protocol, Paragraph 3a). While the CDM has not been without its challenges and controversies (Gillenwater & Seres, 2011; Hinostroza et al., 2007; Winkelman & Moore, 2011), it has arguably remained the best available global concerted effort of tackling climate change by establishing a market for GHG emission reductions.

2.2. Need for CDM in urban housing

It is estimated that 40% of the population in Africa lives in urban areas but this figure is envisaged to rise over 50% by 2050 (United Nations, 2015). With such rapid urbanisation, a persistent rise in the demand for housing in urban sub-Saharan Africa is expected. In Uganda, addressing housing shortage in the capital city (Kampala) alone requires constructing over 28,000 houses annually for at least 10 years (UN-HABITAT., 2010, p.37). However, addressing this housing deficit has not been without unintended consequences. Construction activities in Uganda negatively affect the environment, especially due to unsustainable processes of material production (Muhwezi, Kiberu, Kyakula, & Batambuze, 2012). The technologies used in energy production are highly inefficient, and associated with high levels of pollution (Okello, Pindozzi, Faugno, & Boccia, 2013). The predominant method of constructing urban houses using burnt bricks and cement mortar (UBOS, 2010) is highly associated with carbon emissions since cement and bricks are both energy and carbon intensive materials (Hammond & Jones, 2008; Monahan & Powell, 2011). A recent study (Hashemi, Cruickshank, & Cheshmehzangi, 2015) found that the average energy consumed in small-scale brick manufacturing in Uganda is 5.7 times higher than that in developed countries. In order to pursue a low carbon path to development, in which case implies shrinking the housing deficit in urban Uganda sustainably, consideration of CDM is desirable.

It is against this background that the authors sought to contribute towards the understanding and possible realisation of sustainable urban housing development in Uganda, by proposing the integration of CDM in the development approval process. The proposal culminated from pursuit of three objectives:

1) to describe the existing development approval process (DAP), hereinafter referred to as the as-is DAP,
2) to propose a new development approval process, hereinafter referred to as the to-be DAP, and
3) to demonstrate how CDM can be integrated into the to-be DAP.

The following section identifies the methods used to achieve each of the objectives.

3. Methodology

It was necessary to understand the existing practices before any proposals for improvement could be made. To achieve this, the as-is DAP of buildings was described using the method of process modelling. Process modelling, which is used for descriptive purposes, is often motivated by the need to improve a prevailing process (Aguilar-Savén, 2004; Chinosi & Trombetta, 2012; Fernández et al., 2010) hence it was an appropriate method to adopt. The method of process modelling involved three stages: process discovery, process mapping, and empirical verification (Debevoise & Geneva, 2011; Verner, 2004). In the first stage, relevant subprocess of the as-is DAP were identified. In the second stage, the identified subprocesses were transformed into a process model representing the as-is DAP. In the third stage, the process model of the as-is DAP was checked to confirm whether it had been modelled correctly. This involved using a case study (Yin, 2014) which was appropriate in describing events, processes, and relationships (Denscombe, 2010), to empirically verify whether the process model conformed with formal practice. Semi-structured interviews involving face-to-face interaction were used to collect data. This data collection approach accorded flexibility, such as availing respondents a chance to expound ideas (Creswell, 2014; Denscombe, 2010). Respondents were limited to only subject matter experts (SMEs) who, according to Debevoise and Geneva (2011), are individuals who know a process in detail and also have control over it.

Upon confirming the as-is DAP, the second objective was to propose a new DAP (i.e. the to-be DAP). This was accomplished by using the same process modelling method described in the preceding paragraph, albeit with minor changes. The third stage in the process modelling method was not necessary since the to-be DAP did not require empirical verification – it was non-existent in Uganda.

After designing the to-be DAP, the next objective was to demonstrate how CDM could be integrated into the to-be DAP. A case of emissions associated with a typical dwelling unit that had been approved to be constructed in Kampala was used. The dwelling was considered to be typical because its specifications, such as materials and construction techniques, matched the findings from the Uganda National Household Survey (UBOS, 2010). The cause of emissions was limited to only constructing walls, consistent with recent proposals by UNFCCC (2013b).