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Trends in renewable energy strategy development and the role of CDM in Bangladesh

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ABSTRACT

This article analyses and discusses trends in renewable energy strategy development in Bangladesh and the prospective role of the clean development mechanism (CDM) under the Kyoto Protocol. Use of renewables for electricity generation results in less greenhouse gas emissions compared with fossil fuel energy systems and often offers additional synergistic benefits. Despite the large potential for development of renewable energy sources in Bangladesh, currently their contribution to electricity generation remains insignificant. Existing policies and programs on renewable energy in Bangladesh are reviewed in relation to the specific requirements needed for CDM. A number of barriers are identified that impede the implementation of the CDM mechanism. Overall, it is recommended that more appropriate energy strategies, including a new national renewable energy strategy, need to be formulated and implemented and more suitable institutional settings need to be provided to promote energy sustainability for Bangladesh. Also, the suggestion is made that incorporation of objectives for CDM promotion in the new national renewable energy strategy to tie in with Bangladesh's CDM strategy should assist in advancement of renewables.

1. Introduction

There is a huge gap between the current use of renewables and associated low political ambitions for implementation and the techno-economical potential for renewables in Bangladesh. This gap is compounded by the large need for investment in electricity generation capacity due to increasing demand for electrification. Although a large share of total public investment has been allocated for the development of Bangladesh's energy sector including the electricity sector, poor progress has been made in recent years. Additionally, foreign assistance to finance the electricity sector has been abating due to Bangladesh not being able to meet donor nations' stringent terms and conditions. Other pressing energy issues are: limited access to electricity across the nation and low electricity consumption per capita. For example, in 2002, about 26% of the total population of Bangladesh had access to electricity and electricity consumption was less than 100 kW h per capita per annum for all sectors (GNESD, 2004). Thus renewable energy could play an important future role in Bangladesh in assisting with access and demand issues. However, as is the case for many nations, advancement of renewables in Bangladesh to date has faced challenges with regard to diffusion of technologies as well as the dilemma of being politically desirable but commercially unattractive (Uddin et al., 2006).

This paper first reviews Bangladesh's current renewable energy strategy and institutional settings. It then explores one possible way to overcome financial barrier, the clean development mechanism (CDM) under the Kyoto Protocol, which could be an effective means towards sustainable energy development (Kim, 2004). Some brief background on CDM and its contribution to date in Bangladesh is provided. Also CDM activities of other nations in the region are discussed as a comparison to current experience in Bangladesh—the challenges with regard to the CDM delineated as well as success to date. Arguing that an appropriate policy setting in Bangladesh could leverage the advancement of renewables, the final section discusses the potential role of CDM in the advancement of renewables in Bangladesh.

2. Materials and methods

The energy, environmental and social statistics quoted in this paper are the most recent publicly available data. Field trips to collect data were carried out in Bangladesh during the first quarters of 2006 and 2007 in order to access data at first hand. Unfortunately some data available at the time of the field research was from the late 1990s because more recent information had not been publicly released. To ensure authenticity of data, research methods involved in desk-top assessment and cross-checking of data quoted in the literature and case studies, together with data gathered during field trips which involved interaction with key agencies and international organizations active in Bangladesh's

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energy sector. Also a systematic assessment was performed of documentary evidence regarding strategies, policies and programs linked with renewable energy development in Bangladesh.

Information on the status of CDM project activities and associated statistics were sourced from UNFCCC CDM online databases. Comparative CDM statuses are presented from Bangladesh, Bhutan, Thailand and Vietnam. This is because these nations are case study nations under the sustainable energy development strategy research project carried out at Macquarie University during 2005–2008 (Uddin et al., 2006, 2007, 2008a, b). However, due to lack of reliable and comparable data, some issues relevant to renewable energy and CDM have not been examined in depth. Nevertheless, the assessment presented arguably is quite representative and provides a general indication of the magnitude of the task facing Bangladesh if a sustainable energy future is to be pursued and achieved.

3. Current renewable energy strategies

Development of the energy sector in Bangladesh has been prioritized via the nation's Five-Year Development Plans.[1] Renewables as one of the three main energy sources[2] were focused on for the first time in the 5th Five-Year Development Plan (1997–2002) (GOB, 1998; Siddiqui, 2003; Uddin, 2001). Policy arrangements that are linked to the development of renewables currently in Bangladesh include: fiscal measures and regulatory mechanisms; environmental policy requirements and an institutional framework for policy implementation. These are discussed in the following sub-sections.

3.1. Policy and regulation

The 1996 Bangladesh National Energy Policy released not long before the 5th Five-Year Plan only marginally emphasized environmentally sound energy development including renewables (Doraswami, 1996). Other legal and policy frameworks that encompass reference to the development of renewable energy include: the 1996 Private Sector Power Generation Policy; the 2000 National Policy Statement on Power Sector Reform; the 2001 Remote Area Power Supply Systems Policy; the 2001 Policy Guidelines for Small Power Plants in the Private Sector, which encouraged small-scale (<10 MW) electricity generation and the 2003 Energy Regulatory Commission Act (IDCOL, 2005; UNESCAP, 2005). Additionally, a *draft* Renewable Energy Policy was released in 2002 (MEMR, 2002). This draft policy provided modalities and procedures for financing arrangements, tariff regulations, fiscal and other incentives for implementation of renewables and guidelines for the establishment of an independent renewable energy institution, an institution named Renewable Energy Development Authority (REDA) (MEMR, 2002; UNESCAP, 2005). However, this draft renewable energy policy has not been finalized or implemented to date due to lack of political motivation and strong interest.

3.2. Fiscal measures and regulatory mechanism

Only a few fiscal measures and regulatory policies relevant to renewables have been designed and implemented in Bangladesh. Measures such as exemption of import duties and value added tax (VAT) on solar PV modules and wind turbines are in place (Sarkar et al., 2003). Also currently, under the National Program of Domestic Biogas in Bangladesh, the Government is providing a US$120 subsidy for installing family sized biogas plants[3] (van Nes et al., 2005). A tax holiday for electricity generation plants for up to 15 years was recommended as a fiscal measure in order to increase private sector investment (Amin, 2005), however, it has not been implemented.

3.3. Environmental policy towards development of renewables

The Government's environmental policy framework that refers specifically to the advancement of renewables is the 1992 National Environment Policy (MOEF, 1992). This policy does not have a stand-alone section on the development of renewables, however, policy guidelines concerning renewables are specified under conservation of natural reserves and renewables and reduction of use of wood and agricultural wastes as fuel and enhanced use of alternative sources of energy (MOEF, 1992). These policy guidelines emphasize advancement of renewables and especially the use of wood fuel.

3.4. Institutions and governance

The Ministry of Power, Energy and Mineral Resources (MEMR) is the sole authority administering all activities related to the nation's energy sector including renewables. Although, as mentioned previously, institutionalization of REDA was proposed in 2002 under the draft Renewable Energy Policy, by the end of 2005, the Government decided to establish an alternative independent unit, the Sustainable Energy Development Authority (SEDA) for expediting the use of renewables and alternative sources of energy for electricity generation (Islam, 2005). However, implementation of SEDA has not been as rapid as was anticipated (Islam, 2005) and the full organizational entity of SEDA and its mandate are yet to be established. Nevertheless, the decision to establish SEDA was an important step in acknowledging the need for renewable energy development in Bangladesh (Islam, 2005). Other organizations that are currently involved in renewables include: the Bangladesh Power Development Board (BPDB), the Rural Electrification Board (REB), research organizations in Universities and to a limited extent private sector actors (e.g. Energy Pac, Grameen Shakti). In addition, the Infrastructure Development Company Limited (IDCOL), a state-owned non-banking financial institution that was established in 1997, administers financing of renewables projects among other infrastructure projects in association with international organizations (IDCOL, 2005). IDCOL effectively works to engage local partner organizations such as NGOs and community groups and end users in projects. The implementation approach of the IDCOL program is given in Fig. 1.

3.5. Experience from renewable energy application

Modern application of renewable energy in Bangladesh is not new, but electricity generation from renewables has been confined to demonstration (household or community based) or early commercialization stages. Current renewable energy technologies for electricity generation[4] include: solar photovoltaics

[1] After the expiry of the 4th Five-Year Plan (1990–1995), no medium term development plan was formulated during 1995–1997. The 5th Five-Year Plan was launched in 1997. Following expiry of the 5th Five-Year Plan in 2002, the nation is undergoing a 3-year Rolling Plan (2004–2007) (Siddiqui, 2003).

[2] Energy (electricity); oil, gas and mineral resources; and renewables.

[3] This assumes a biogas production of 47 l/kg of dung. Average capacity of a biogas plant is about 2.8 m^3 gas production daily (van Nes et al., 2005).

[4] Thermal energy generation includes: solar cookers, dryers, water heaters and tunnel dryers for crops; biomass briquetting and improved cooking stoves. Compared with traditional cooking stoves, improved design reduces emissions

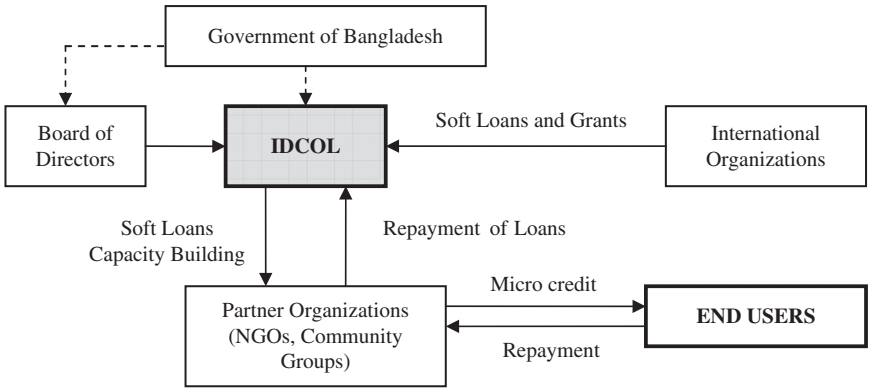

Fig. 1. Implementation approach of the IDCOL program.

(PV) as solar home systems (SHSs); biogas for electricity generation; small hydropower and to a limited extent wind electricity generation.

3.5.1. *Application status of and potential for renewable energy technologies*

The first solar PV system installed in Bangladesh, and the largest installation to date, was a 62 kW system in the Narshingdi District in 1997 (Uddin, 2001). Currently over 1000 kW of solar PV applications and over 45 000 SHSs are operating in Bangladesh (IDCOL, 2005; Sarkar et al., 2003). Also there are over 19 500 biogas plants operating in Bangladesh (Islam et al., 2006). Initial initiatives by the very successful micro-credit[5] program of Grameen Shakti[6] (Timilsina et al., 2001) and the recent innovative implementation approach of IDCOL have been instrumental in the advancement of these technologies. IDCOL expects to finance an additional 200 000 SHSs by 2009 under its Rural Electrification and Renewable Energy Development Project (IDCOL, 2005). Also under the National Program of Domestic Biogas, IDCOL expects to install 60 000 domestic size biogas plants during 2006–2010 (IDCOL, 2005). These initiatives are expected to change the living standards in remote rural locations of Bangladesh through providing access to clean energy for cooking and green electricity for lighting purposes (Uddin et al., 2006).

Bangladesh also has developed biomass energy, wind and to a limited extent small hydropower[7] (Islam et al., 2006; Sarkar et al., 2003; Uddin, 2001). Biomass accounted for nearly 50% of the nation's total energy supply in 2004 (Hossain and Tanim, 2005) and supplied 98% of total renewable energy[8] (IEA/OECD, 2004). Also initiatives involving the installation of SHSs[9] and biogas plants are flourishing compared to other renewable energy technologies (Siddiqui, 2003). Although the potential for wind energy is good, however, its penetration has been very small to date (ADB, 2003). Other renewable energy sources like geothermal, tide, wave and OTEC require further assessment (ADB, 2003). The overall prospects for renewable energy in Bangladesh according to a 2003 ADB study are given in Table 1.

Table 1
Renewable energy prospects for Bangladesh

Type	Reported installed capacity	Potential
Wind	50 kW	2000 MW
Hydro	230 MW	672 MW
Solar PV	1026 kW	50 463 MW
Solar thermal	800 m^2	20 million m^2
Geothermal	Nil	Needs investigation
Tidal, wave, OTEC	Nil	Needs investigation
Biogas	50 000 m^3	3675 million m^3

Source: ADB (2003).

3.5.2. *Experience from renewable energy applications to date*

Intervention from Government institutions, donor organizations and the private sector has facilitated dissemination of renewable energy technologies on the ground in Bangladesh since the early 1980s. Besides IDCOL's initiatives, a number of pilot programs have been initiated to implement solar PV, SHSs, wind plants and biogas technology mostly under Government—donor partnerships schemes (IDCOL, 2005; Sarkar et al., 2003; Siddiqui, 2003; Uddin et al., 2006). Unfortunately, most of these initiatives ceased after the completion of pilot schemes. As such, there has been mixed success with certain projects which appears to be often due to a lack of local stakeholder interest,[10] effective engagement of such interests when they do exist, and requirements for systems reliability and maintenance (Biswas et al., 2001). For example, the early experience from a 62 kW solar PV demonstration project in Narshingdi district indicated potential for further applications of such systems. However, operation of this facility has been challenging due to maintenance requirements and the system's reliability (Biswas et al., 2004).

Since the late 1990s, some steps have been taken to integrate local communities and other stakeholders in decision-making processes regarding renewables. Local business entrepreneurs and

(*footnote continued*)
and increases combustion efficiency. However, this paper only reflects on electrical energy generation.

[5] The micro-credit mechanism has three different payment options for renewable energy installation. Option 1: Customers pay upfront a small (15%) portion of the system cost and the remaining 85% is to be paid in monthly installments over a period of 3 years with a 12%/year service charge. Option 2: Customers pay 25% upfront costs and the remaining 75% is paid over 2 years with 8%/year service charge. Option 3: Customers can buy a system paying the total cost upfront with a 4% discount on the system cost (Siddiqui, 2003).

[6] Grameen Shakti is a sister organization of the Grameen Bank (literally 'rural bank').

[7] Small hydropower capacity is <10 MW. The limited potential for small hydropower is related to the flat terrain of the nation.

[8] This biomass is categorized as renewable energy. Although there are links with biomass usage and deforestation in some nations, there is a lack of evidence that the use of biomass for fuel is resulting in deforestation in Bangladesh.

[9] SHSs consist of a PV panel that catches sun rays as directly as possible, convert solar energy to electricity and charges a storage battery.

[10] Local stakeholder interest groups include: end-users, local service and maintenance providers and entrepreneurs.

members of local communities of both genders have been encouraged to actively participate in renewable energy development programs. For example, IDCOL's National Program on Domestic Biogas focused on engagement of multiple stakeholders (Ghimire, 2005). Another example is manufacturing of battery operated lamps by rural women which has been initiated under the Coastal Electrification and Women's Development Micro-Enterprise (CEWDM) Project (ESMAP, 2004; Khan, 2003). Renewable energy technologies, if used effectively via community engagement in rural areas, could enhance electricity accessibility and hence lift peoples' living and social standards.

3.5.3. Impediments for advancement of renewables

A number of underlying issues and barriers that have constrained deployment of renewable energy technologies in developing nations include: lack of adequate policy frameworks, institutional settings, markets, financing, technological development, human resources and slow diffusion rates of new technologies (Painuly, 2001; Yu, 2003). In the industrialized nations' context, for example in the situation of remote region's of Australia, malicious damage[11] has been recognized as a new impediment for adoption of renewable electricity systems (McKenzie and Howes, 2006). Externality costs[12] also act as market barriers for advancement of renewable energy technologies (Owen, 2006). Many of these impediments are also applicable in the context of Bangladesh. Lack of effective community engagement in adoption of renewable energy technologies is evident in rural Bangladesh. Additionally, unrealistic political promises for unplanned electricity grid expansion have been another policy challenge. This has had the impact on dampening deployment of renewables in Bangladesh.

4. Clean development mechanism (CDM)

CDM is one of the three flexible mechanisms[13] under the Kyoto Protocol (Article 12), which entered into force on February 16, 2005 after nearly eight years of negotiations. The Kyoto agreement includes legally binding reduction targets[14] for Annex 1 Parties, i.e. industrialized nations. CDM gives industrialized nations an opportunity to finance greenhouse gases mitigation projects (for example renewable energy projects) in developing nations (Non-Annex 1 nations) with the aim of contributing to sustainable development while also helping industrialized nations meet their greenhouse gas emission reduction commitments under the Kyoto Protocol in a cost-effective manner. The UNFCCC Secretariat administers the CDM project cycle[15] with the aim of adequate interaction with all stakeholders in a transparent manner. Each tonne of CO_2 equivalent reduced in a developing nation from a registered project after fulfilling all the requirements by the CDM Executive Board becomes registered as one Certified Emission Reduction Unit (CER)[16] at the UNFCCC Registry and becomes tradable on the carbon market. CDM is thus a financing tool which can lead investments into clean energy technologies and especially renewables which will contribute to sustainable development beyond climate change mitigation. Additionally, CDM is an international mechanism that provides a platform for the creation of a wide array of partnerships with the private sector, national governments and other stakeholders (Streck, 2004).

4.1. Policy and governance of CDM

In response to concerns about global climate change and the possibility of hosting CDM investments, Bangladesh ratified the Framework Convention on Climate Change in 1994 and acceded to the Kyoto Protocol in 2001. It thereby qualified to participate in greenhouse gas mitigation projects and in particular renewable energy projects under the CDM. The principles of the CDM strategy developed by the Bangladesh Government state that CDM projects shall have tangible national impacts and will contribute to the national sustainable development as well as contribute to the improvement of the environment and the welfare of society as whole.

The Government of Bangladesh has institutionalized CDM in order to attract and mobilize CDM financing. It is a requirement by the UNFCCC that CDM project activities are approved by the respective authority in the host nation. The Department of Environment (DOE) under the Ministry of Environment and Forests (MOEF) serves as Bangladesh's focal point to the Framework Convention on Climate Change and acts as the Secretariat of the Designated National Authority (DNA). The DNA is responsible for approval of greenhouse gas emission reduction projects including renewable energy projects under the CDM scheme (UNFCCC, 1998). The Bangladesh DNA is a two-tier authority: the National CDM Board, which endorses CDM project activities and the National CDM Committee, which approves CDM project activities. The Principal Secretary of the Prime Minister of Bangladesh serves as the Chairman of the National CDM Board. This Board is composed of members from the MOEF, the Planning Commission and other relevant Ministries. The Director-General of the DOE serves as a Member-Secretary. The National CDM Committee is chaired by the Secretary of the MOEF and includes representatives from relevant Ministries, Government organizations and NGOs. The structure of DNA in Bangladesh is given in Fig. 2.

4.2. Status of CDM projects and potential for future initiatives

While investment into renewable energy and energy efficiency projects in 2006 was approximately triple official development assistance support for energy policy and renewable energy projects in many developing nations (Clemencon, 2008), however, Bangladesh did not mobilize significantly investment in renewables and particularly in relation to advancement of renewables under CDM. Although Bangladesh has set up an institutional structure for CDM, only a few project activities have been administered by the DNA. Table 2 provides an overview of the current status of CDM project activities in Bangladesh. To date, only two projects (composting organic waste and landfill gas extraction and utilization) have been registered as CDM project

[11] Often referred as deliberate sabotage.

[12] External costs include environmental and health damage costs due to pollution from combustion of fossil fuels. Costs borne by governments, including direct subsidies, tax concessions, indirect energy industry subsidies (e.g. the cost of fuel supply security) and support of research and development costs are not externalities. They do, however, distort markets towards negative externalities, leading to increased consumption and hence environmental degradation (Owen, 2006).

[13] Clean Development Mechanism, Joint Implementation and International Emission Trading.

[14] Reduction targets are for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and chlorofluorocarbons (CFCs).

[15] The CDM project cycle consists of the stages of validation, registration, monitoring, verification, certification and issuance of Certified Emission Reductions (CERs) according to CDM methodologies and procedures.

[16] A certified emission reduction or CER is a unit issued pursuant to Article 12 and requirements thereunder, as well as the relevant provisions in the CDM modalities and procedures, and is equal to 1 ton of carbon dioxide equivalent, calculated using global warming potentials defined by decision 2/CP.3 or as subsequently revised in accordance with Article 5 of the Kyoto Protocol.

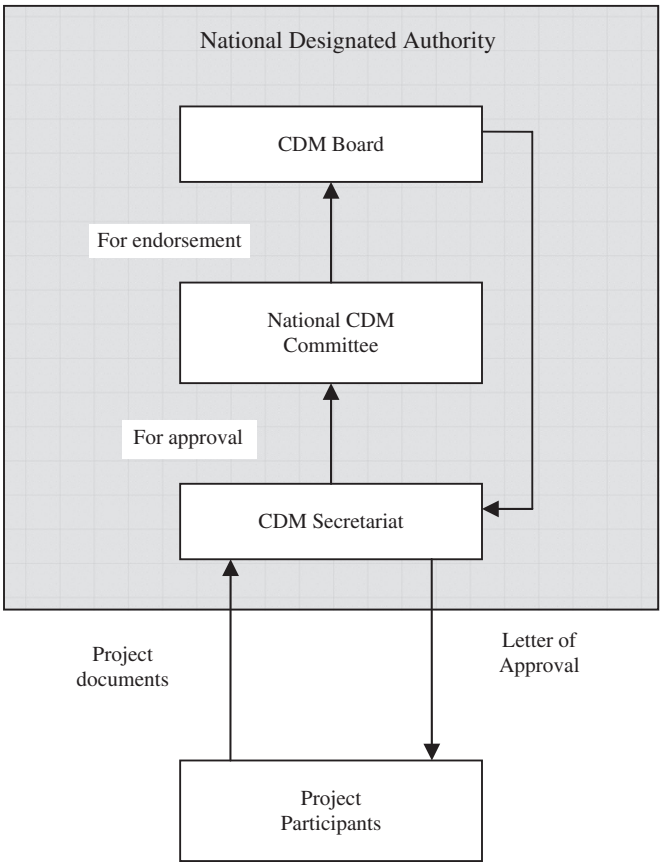

Fig. 2. Structure of CDM DNA of Bangladesh.

activities (UNFCCC, 2008), and two projects (renewable electricity) are at the validation stage.

The emissions reduction potential of CO_2 from least-cost greenhouse gas mitigation projects in the energy sector in Bangladesh has been estimated to be around 50 million ton of CO_2 per year according to the Asia Least-Cost Greenhouse Gas Abatement Project (ALGAS) (ADB et al., 1998).[17] Thus mitigation of CO_2 emissions (about 2.5 million ton of CO_2 per year) from the currently designed CDM project activities remains insignificant compared with the estimated potential reduction of CO_2 emissions. However, as discussed, Bangladesh has considerable potential for CDM project activities under the Kyoto Protocol and, in particular, potential application of renewable energy projects under the CDM scheme. Future CDM project activities could be developed adopting IDCOL implementation approach where a large number of single users or communities are involved. Potential project activities could be wind electricity generation in coastal regions; solar-assisted water pumping for irrigation and there is potential for small hydropower plants. A national CDM program of activities could also be developed if relevant modalities and procedures are put in place and facilitated by the UNFCCC.

4.3. Challenges with regard to development of CDM in Bangladesh

The reason only a tiny portion of total greenhouse gas reduction projects have been identified as CDM project activities is due to lack of knowledge and understanding about the CDM scheme among project developers in Bangladesh, personnel from government institutions and other stakeholders. There are several factors that may impede CDM schemes involving renewables in Bangladesh including: high transactional costs for small-scale renewable energy projects especially due to low energy demand in remote/isolated and off-grid locations; lack of favourable policy guidelines; lack of an investment culture which involves willingness to take business risks; heavily dependence on external assistance with CDM activities and lack of dissemination of information about successful CDM implementation.

4.4. Contribution of CDM in neighbouring nations

This section reviews the status of current CDM project activities in other nations: Bhutan, Thailand and Vietnam as a comparison to the level of activity in Bangladesh. All these nations are Parties to the Framework Convention on Climate Change and they have signed and ratified the Kyoto Protocol.

4.4.1. Bhutan

Although being a very small and landlocked nation, Bhutan has had experience in commissioning a first small-scale CDM project activity[18] under the Kyoto Protocol. The e7 Bhutan Micro-Hydropower CDM Project[19] was registered on 23 May 2005 as a CDM project activity. This project activity expects to reduce 524 ton of CO_2 per year (Uddin et al., 2007). The overall objectives of the project include: to demonstrate a first project under the CDM scheme; to construct a micro-hydropower scheme in the remote village of Chendebji; to support rural electrification; to realize the synergistic benefits to rural communities and to contribute to the CDM rule-making process by addressing the challenges and measures undertaken from project initiation to implementation (Ikoma and Tshering, 2005; Uddin et al., 2007). Early development of this small-scale CDM project activity offered a great deal of lessons to both Japan (as the partner Annex 1 nation) and Bhutan (as host nation) via administration and implementation of the CDM project activity according to the UNFCCC modalities and procedures—especially with engagement of local stakeholders in decision-making, the functions of the DNA, as well as capacity building and development of human skills (Uddin et al., 2007). While there is no specific CDM related policy in Bhutan, Bhutan's specific hydropower development policy ensures future development of hydropower project under CDM scheme. Nevertheless, establishing functional CDM institutions and simplified CDM approval procedures in Bhutan has been seen as a good example to other developing nations.

4.4.2. Thailand

Although Thailand has considerable potential for renewable energy projects which could be developed under the CDM

[17] This is the only comprehensive study on Bangladesh and was done under the Asia Least-Cost Greenhouse Gas Abatement (ALGAS) project which covered 11 nations from the Asian region.

[18] In accordance with Decision 17/CP.7 simplified modalities and procedures have been developed for the following types of small-scale CDM project activities:

(i) Renewable energy project activities with a maximum output capacity equivalent to up to 15 MW (or an appropriate equivalent);
(ii) Energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, by up to the equivalent of 45 GW/h per year;
(iii) Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kt of carbon dioxide equivalent annually.

[19] The Chendebji 70 kW micro-hydropower project is financed by the e7 Fund. e7 (then now e8) is an international group composed of largest electrical utilities from G7 nations. The e7 mission is to play an active role in global electricity use and to promote sustainable development.

Table 2
Current CDM project activities in Bangladesh

Projects	Status	Emission reduction (ton of CO_2e/year)	Financing
Landfill gas extraction and utilisation at Matuail landfill site, Dhaka	Registered (17 September 2005)	80 000	WWR[a] and Tridos Bank, The Netherlands
Composting of organic waste in Dhaka (700 ton/day)	Registered (18 May 2006)	89 259	WWR and Tridos Bank, The Netherlands
30,000 solar home systems in non-grid areas	Validation	10 000	Grameen Shakti, Bangladesh
Promotion of 100,000 compact fluorescent lamps in rural areas	Validation	5000	Energy Pac and Grameen Shakti, Bangladesh

Sources: UNFCCC (2008).
[a] WWR—world wide recycling.

Table 3
Registered CDM project activities in Thailand

Project title	Registered	Technologies	Capacity (MW)	Emission reductions (ton CO_2e/year)
A.T. Biopower Rice Husk Power Project in Pichit	18 June 2007	Biomass to energy	22	70 772
Phu Khieo Bio-Energy Cogeneration Project (PKBC)	19 October 2007	Biomass to energy	41	102 493
Dan Chang Bio-Energy Cogeneration Project (BCBC)	19 October 2007	Biomass to energy	41	93 129
Khon Kaen Sugar Power Plant	27 July 2007	Biomass to energy	30	61 449
Korat Waste to Energy	16 June 2007	Biogas to energy	5	310 843
Ratchaburi Farms Biogas Project at SPM Farm	24 March 2008	Biogas to energy	2.22	23 556
Ratchaburi Farms Biogas Project at Nong Bua Farm	27 March 2008	Biogas to energy	2.22	15 958
Ratchaburi Farms Biogas Project at Veerachai Farm	28 March 2008	Biogas to energy	2.22	32 092
Surat Thani Biomass Power Generation Project in Thailand	10 May 2008	Biomass to energy	9.95	106 592
Jaroensompong Corporation Rachathewa Landfill Gas to Energy Project	14 March 2008	Landfill gas	1	47 185

Sources: UNFCCC (2008).

scheme, until now only 28 projects[20] have received approval from the Thai DNA. Around 20 projects are in the pipeline. However, out of these approved project activities only 10 projects have been registered as CDM project activities under the Kyoto Protocol. Table 3 provides details of registered Thai CDM projects with the UNFCCC. Among the 10 registered CDM projects, six will produce electricity from biomass combustion and another four project activities will produce electricity from biogas.

Thailand has great potential for development of renewables other than biomass such as solar, small-hydro and municipal solid waste (Uddin et al., 2006); however, only biomass-based project activities have received marked attention from CDM project developers. Although, the current vision for CDM project activities in Thailand is limited to medium-to-small scale, Thailand has the potential for a programmatic CDM approach (Weiss et al., 2008), for example, with implementation of a national ethanol program for the transportation sector (Amatayakul and Berndes, 2007). However, such programmatic approaches are still limited[21] due to lack of tailored methodologies for such CDM program of activity.

Thailand has experienced slow progress of CDM activities especially with regard to its approval process as a host nation due to the constraints of its institutional and decision-making framework. However, the Thai Government realizes the challenge of climate change issues and in particular management of CDM issues, established a new organizational structure, the Thailand Greenhouse Gas Management Organization (TGO),[22] as a public authority to act as the DNA for the CDM Secretariat Office which is now operating in Thailand. The implementation of the TGO as a new agency in Thailand has been seen as more effective by CDM project developers compared with Thailand's previous complex and bureaucratic CDM institutional arrangements (Cooper, 2007). However, public opinion about issues associated with afforestation/reforestation and forestry projects under CDM has had a dampening effect on the Thai Government's willingness to approve implementation and CDM projects and consequently projects of this type will not be considered for the CDM scheme by the Thai DNA. Nevertheless, Thailand is a leader among South East Asian nations in attracting CDM investments and is expected to play an important role in fostering CDM in the region.

4.4.3. Vietnam

Vietnam has been attempting to take an early and active role in the CDM market and mobilize investment opportunities under the scheme (Tuyen and Michaelowa, 2006). Although Vietnam has considerable potential for deployment of renewable energy projects under CDM scheme (Uddin et al., 2008a, b), only two projects have been registered as CDM project activities and eight projects are at the validation stage. Table 4 provides an overview of the current status of CDM project activities in Vietnam.

Among these project activities, seven projects are designed to generate electricity from renewable resources. Six of the electricity generation projects are based on hydropower and it is estimated they will result in a total reduction of emissions of over 8.5 million ton of CO_2 per annum with a total installed capacity of 144 MW (MONRE, 2005). Out of this installed capacity, only about

[20] Seven promptly started projects were approved by the Cabinet Resolution on 30 January 2007; these were followed by eight project activities on 28 August 2007 (Cooper, 2007). An additional 13 projects were approved under the New Thailand Greenhouse Gas Management Organization (TGO) as of 10 March 2008.

[21] There has not been any programmatic CDM scheme in any other nations; however, UNFCCC is currently facilitating the modalities and procedures for such scheme.

[22] As a result of the Royal Decree on Thailand Greenhouse Gas Management Organization (Public Organization) Establishment B. E 2550 (2007).

Table 4
CDM project activities in Vietnam

Project title	Status	Emission reduction (ton CO_2e/year)	Technology
Rang Dong Oil Field Associated Gas Recovery and Utilization Project	Registered 04 February 2006	667 000	Recovery and utilization of by-product gases from oil production activities
Song Muc Hydro Power Station Regeneration Project	Registered 26 June 2006	4306	Renewable electricity generation from hydropower plant
Anaerobic Wastewater Treatment and Energy Recovery Project at Rubber Producing Company	Validation	9310	Recovering biogas from the wastewater in the rubber producing factory and use to generate electricity with gas engine
Ngoi Duong Hydro Power Project	Validation	30 137	Renewable electricity generation from hydropower plants
Song Con Hydro Power Project	Validation	112 711	Renewable electricity generation from hydropower plants
The Model Project for Renovation to Increase the Efficient Use of Energy in Brewery	Validation	6279	Energy conservation in a medium-size brewery
Za Hung Hydro Power Project	Validation	634 000	Renewable electricity generation from hydropower plants
Nam Chim Hydro Power Project	Validation	33 149	Renewable electricity generation from hydropower plants (run-of-the river type and grid connected)
Song Giang 2 Hydro Power Project	Validation	57 211	Renewable electricity generation from hydropower plant
The model project for renovation to increase the efficient use of energy in brewery	Validation	8804	Energy conservation in brewery

Source: UNFCCC (2008).

13 MW of electricity will be harnessed from small scale hydropower plants, the remainder being large scale hydropower projects (MONRE, 2005). This amount represents less than 1% of the total Vietnamese potential for small hydropower generation (Uddin et al., 2008a, b). Thus, mitigation of CO_2 emissions from the electricity sector and the installed capacity of electricity generation from renewable resources under CDM schemes remain insignificant compared with the potential for emissions reduction and clean electricity generation.

Vietnam possesses early experience on CDM activities through external assistance. Although Vietnam has set up an effective institutional arrangement for CDM there are several factors that may impede development of renewable electricity projects. These include: competition from cheaper electricity from large hydropower schemes; full implementation of south-east Asian regional energy cooperation and electricity trade between Greater Mekong Sub-Region (GMS) nations[23] as well as foreshadowed initiatives with regard to implementation of nuclear electricity in Vietnam (EIA, 2005). However, Vietnam has achieved early success in CDM administration and is expected to continue to search for improvements in policy-making and learning. To overcome such impediments, the Government of Vietnam has taken some steps via initiation of several measures which will enhance CDM activities in the nation. These include integration of CDM into the draft National Energy Policy as well as a proposed financing mechanism for CDM projects (MONRE, 2007). However, these measures are yet to be implemented.

5. Role of CDM in advancement of renewables

As discussed earlier, deployment of renewables in Bangladesh faces a number of barriers. Some of these barriers are also relevant when designing a renewable electricity project activity under the CDM scheme. Although the CDM scheme provides additional financing for advancement of renewables it faces important challenges: a low quantity of CERs and associated high transactional costs for CDM activities; and the dilemma of additionality. These are discussed in the following sub-sections.

5.1. Low quantity of CERs versus high transactional costs

The capacity of renewable electricity projects generally is small and they only generate small amounts of CERs. Therefore, the transactional cost of renewable electricity projects under the CDM scheme is higher compared to other CDM project activities (for example HFC reduction projects) when considering revenue from generated CERs. Therefore, investor and project developers have a stronger preference for large CDM projects with low transactional costs than for smaller ones, such as solar PV, SHSs, small hydropower, etc. At the same time, the price of the CERs varies according to project risk and additional quality requirements like the CDM Gold Standard[24]—to ensure sustainability criteria for the developed project activity. Also among different potential renewable energy projects, biomass-, and biogas-based projects acquire more CERs than those from solar PV or small hydropower, when renewable electricity from these sources replaces fossil-based electricity in a specific geographical context.

5.2. Dilemma of additionality

The regulative requirements for CDM project activities as set out in the Marrakesh Accords and further developed by the CDM Executive Board of UNFCCC require CDM project activities to be additional to business as usual. The additionality requirement is justified because it upholds the environmental integrity of the CDM process and assists in ensuring sustainability requirement. The additional reduction of GHG emissions from a CDM project activity should ensure a global net reduction of GHGs. The

[23] GMS nations include: Thailand, Vietnam, Laos, Cambodia and Yunnan Province of China.

[24] The Gold Standard Foundation offers a quality label to CDM project with sustainable development benefits. The Gold Standard is endorsed by round 50 NGOs worldwide.

additionality of any project activity is demonstrated via the tool of additionality developed by the CDM Executive Board as addressed to a specific project case. Thus this can pose a perverse incentive for a host nation not to implement progressive policies for the advancement of renewables. However, guidance from the CDM Executive Board has resulted in relevant national policies implemented after 2001 being excluded when addressing additionality.

In addition to these challenges, significant uncertainties have existed with regard to the future of CDM and the Kyoto Protocol after the first commitment period from 2008 to 2012. However, progress now is being made towards future commitments under the Kyoto Protocol. For example, discussions have been initiated for a road map towards the Copenhagen 2009 Conference of Parties, where future commitments under the Kyoto Protocol may be adopted by the UNFCCC. Relevant negotiations and modalities are yet to be devised.

As discussed previously, realizing the potential for CDM financing to overcome barriers for advancement of renewables, Bangladesh has institutionalized CDM. Its CDM strategies focus on national interest in energy sustainability. While the implementation of CDM project activities is maturing, Bangladesh could benefit from an invigorated approach to CDM, i.e. inclusion of a CDM program of activities that focuses on renewables. However, obtaining CERs from CDM scheme may not be enough to make renewable energy projects for electricity generation attractive in Bangladesh, i.e. CERs as a source of revenue may have to be supplemented by additional start-up funds provided by the investor nations.

6. Concluding remarks

In Bangladesh, the diffusion of renewable energy technologies has gained momentum in recent years via evolution of relevant policies, institutional facilitation and learning-by-doing experience. However, the current policy measures and institutional structures that have been put in place should be considered only as initial steps towards further development of renewables. While a UN agreement on preferential treatment of renewable energy beyond CDM is somewhat unlikely at the present, enabling national policy could enhance the CDM contribution towards deployment of renewables. For example, Bangladesh could benefit via development of a national renewables strategy integrated with its CDM strategy as has been done in other Asian nations, e.g. Thailand and Vietnam. Further, an effective institution for greenhouse gas management could be realized in Bangladesh similar to the TGO in Thailand.

Bangladesh's national energy policy should be linked with a new national renewable energy strategy and have explicit targets on renewable energy as well as provision for an institutional platform for administering these measures. The strategy should broadly encompass appropriate incentives for the advancement of renewables at initial stages and should contain provision for gradual phasing out of such measures.

Bangladesh currently is gaining experience with several renewable energy projects and CDM schemes. Though these initiatives are at initial stages of implementation, the potential success of these initiatives is high with regard to abatement of greenhouse gas and their contribution to sustainable development. These viable approaches need to be amplified to a broader context with the new national renewable energy strategy.

Monitoring of renewable programs progress and policies as well as a mechanism for provision of knowledge about best practice examples of successful schemes in Bangladesh should be put in place as a basis for future policy adaptation, modification or reorientation, especially with regard to CDM for the nation. Also mobilization of finance, realization of niche markets for renewable energy, research and development on new and innovative financing mechanisms (such as CDM) and strengthening of human capacity are further important avenues towards energy sustainability for Bangladesh.

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